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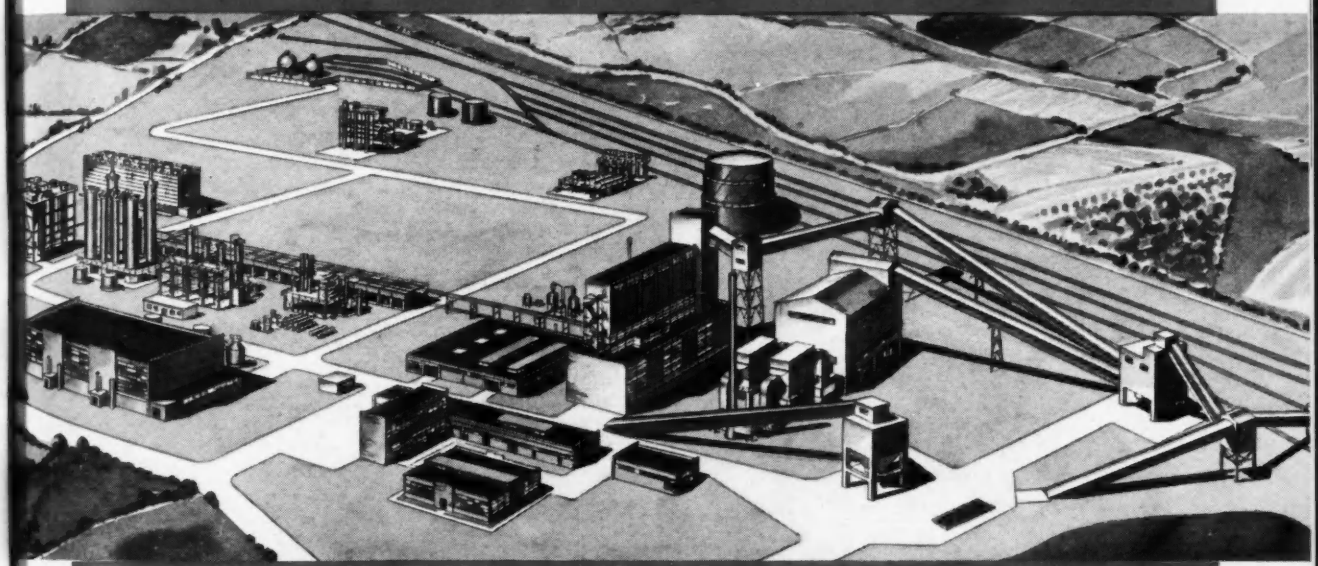
THE UNIVERSITY OF MICHIGAN
JUN 30 1960
ENGINEERING

TOWN GAS
FROM
LOW RANK COAL



An artist's impression of Great Britain's largest High Pressure Coal Gasification Plant at the Coleshill Works of the West Midlands Gas Board. The installation includes Lurgi complete gasification generators and will process low rank small coals from the Midlands coalfields and produce 40 million cubic feet of Town Gas daily. The Plant has been designed for future extension in two stages which will double and then treble this capacity.

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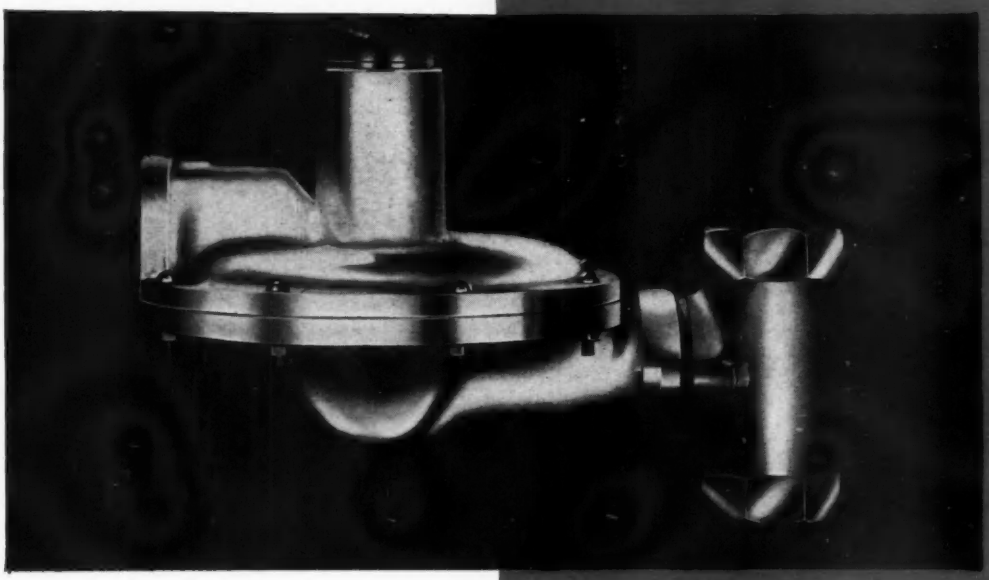

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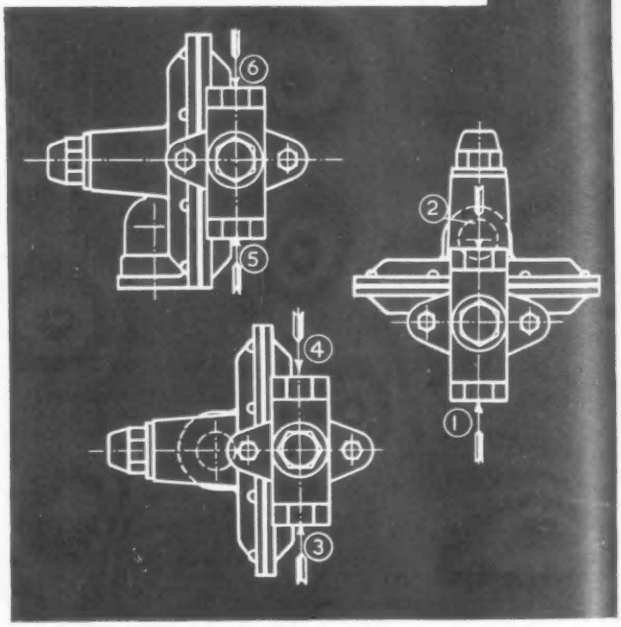

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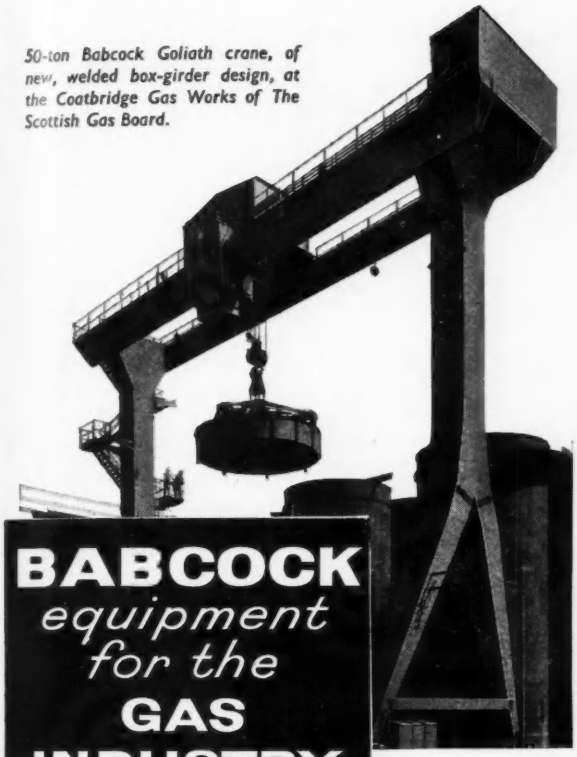

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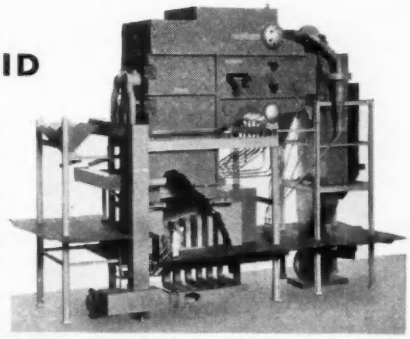

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Gas Journal

VOLUME 302 • NUMBER 5050 • 112th YEAR

WEDNESDAY, JUNE 15, 1960

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PUBLISHERS' NOTICE, SEE PAGE 352, JUNE 1, 1960

the study of movement

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TG49

Review of the I.G.E.'s 97th Annual General Meeting

FOR the first time for 60 years the Institution of Gas Engineers held its Annual General Meeting this year at Edinburgh, the second consecutive meeting to be held outside England. It had much of the pleasant intimacy of last year's meeting at Llandudno, plus a setting which even the most ardent Welshman must regard with, if not envy, respect. A splendid city with public buildings to grace such a gathering and, within easy reach, one of the most interesting and important gas projects to be undertaken in Britain—what more could one want? Only what has become known as ' Institution weather ', and that was available too.

Sixty years ago when the Institution last met in Scotland's capital it was under the presidency of Mr. W. R. Herring. It nearly met there again in 1944 under Mr. James Jamieson but D-day intervened. And so the Institution had to wait until the election of Mr. Duncan D. Melvin, Member of the Scottish Gas Board, before it could return to Edinburgh. It was a long wait, but it was worth it!

The annual general meeting opened in the Usher Hall on May 31 with an elegantly worded welcome to Edinburgh by Bailie Peter McDiarmid, deputising for the Lord Provost. We might perhaps quote his reference to the President : ' Duncan Melvin is one who, in our City, has won for himself very high respect, admiration and affection.

Delegates crowd Edinburgh's Usher Hall during the opening session.

As a former Engineer and Manager of our Edinburgh Corporation Gas Undertaking, he made many friends within our City, and many of us, both in the Corporation and outside the Corporation, enjoy this very great privilege of calling him a friend. This morning it gives us particular pleasure and very great joy to see him taking the Chair in this very highest office of your Institution.'

And we liked Bailie McDiarmid's hint of what is purported to be a Scottish characteristic—the only reference of its kind to be made during the meeting. Advising members not to worry unduly about car parking, he said: 'In Edinburgh, we will not tow your car away. We know how many of you there are—roughly a thousand men, most of them with cars. A thousand men with cars, and a fine, if we only catch you once, at £2 a time, is £2,000!'

After the traditional loyal greetings, the President gave the usual welcome to representatives of overseas gas associations. Those mentioned were as follows: From Australia, Mr. W. H. Jones and Mr. R. J. Maher, both from the Australian Gas Light Company; from Belgium, M. R. H. Touwaide, Honorary Member of the Institution, Secretary of the Association Royale des Gaziers Belges, Secretary General of the International Gas Union; from Denmark, Mr. N. R. Jakobsen, President of the Danish Gas Association and also a member of the Institution; from France, M. Y. Quéret, President

Friends from overseas: M. A. Renauldon, M. P. Bernard, M. Y. Quéret, M. P. Mougin, and M. D. Raeber.

of the French Gas Association, M. M. Bernard, Assistant Director General, Gaz de France, M. P. Mougin, formerly Inspector General, Gaz de France, M. A. Renauldon, an Associate of the Institution, also from Gaz de France; from Holland, Mr. J. van Dam van Isselt, President of the Netherlands Gas Association; from Italy, Professor Dr. M. Spaggiari, from Rome, Mr. Novi and Dr. Böhm from Turin, also a member of the Instituiton. There were members from Pakistan, Mr. G. C. Wood; from South Africa, Mr. G. Annable, Johannesburg; a representative from Switzerland in Mr. Raeber, the Secretary of the Swiss Gas Association; and from the United States, Mr. Karl B. Nagler.

It was Mr. Nagler who responded.

The Institution journal

The Hon. Secretary, Dr. W. T. K. Braunholtz, having read the greetings from overseas gas associations, and the minutes of the 96th A.G.M. having been confirmed, the President commented on the Annual Report, in particular that section dealing with publications. Having expressed concern about the heavy burden incurred by the present costs of printing the bulletin, communications, transactions and other publications, which charges had again increased following the last wages award in the printing industry, the President said: 'It is clear that something must be done without delay to reduce this burden and this is one of the reasons why your Council has decided to discontinue, as from January next, the publication of the transactions and bulletin and to replace them by a monthly journal. This, in common with the journals of our kindred institutions, will carry a limited proportion of advertising matter and the revenue to be derived from the latter is expected to go a long way towards reducing our printing costs and so placing our finances in a healthier position.'

Election of officers

The 97th Annual Report of the Council for the year 1959-60 and the accounts for the year 1959 having been adopted, we came to the results of the ballot for the election of officers, auditors and ordinary members of Council: President, 1960-61, Mr. H. S. Cheetham, Director, Woodall-Duckham Construction Co. Ltd.; Vice-President for the next two years, Dr. A. E. Haffner, Member and Chief Engineer of the Southern Gas Board; Honorary Secretary for the coming year Mr. G. E. Currier, O.B.E., Deputy Chairman, North Eastern Gas Board; Auditors, 1960-61, Colonel Sir Harold Smith, and Mr. Peter Davey; As Ordinary Members of Council, 1960-61 Mr. J. Castle, General Manager Mersey Group, North Western Gas Board; Mr. L. J. Clark, Assistant Chief Engineer (Development and Planning) North Thames Gas Board; Mr. A. V. Horsfall, Sales and Service Manager, West Midlands Gas Board; Mr. W. Sutcliffe, General Manager, Tyneside Division, Northern Gas Board.

The Secretary reported that all the names on the ballot list had been duly elected: 23 Honorary Members, including one in Australia who unfortunately could not attend, Dr. Andrews; three Members, 65 Associate Members and 23 Associates. He drew attention to one name in the ballot list for Associate Members, that of Miss Nancy Farrow, who became the first lady Corporate Member of the Institution.

The President, Mr. Duncan D. Melvin, with his successor Mr. Hugh S. Cheetham.

District Members of Council nominated by the District Sections of The Institution and affiliated District Gas Associations, for the year 1960-61 were reported as follows: Mr. D. Beavis (Edinburgh), Scottish; Mr. J. K. Cantwell (Wexford) Irish; Mr. J. D. Grant (London) British Junior Gas Associations' Joint Council; Mr. S. K. Hawthorn (Birmingham), Midland; Mr. J. A. Hepworth (London), London and Southern; Mr. H. B. Kendrick (Conway), Wales and Monmouthshire; Mr. A. H. Nicholson (Manchester), Manchester and District; Mr. A. C. Rea (Bath), South Western; Mr. B. Richardson (Newcastle-upon-Tyne), North of England; and Mr. E. H. Winch (Cambridge), Eastern.

Medals and prizes

The President then presented the medals and prizes which had been awarded for outstanding contributions made to technical meetings and for services rendered to the gas industry. Foremost among these is the Birmingham Medal which is awarded by the Institution at intervals of not less than two years 'for originality in connection with the manufacture and application of gas, such qualification to be interpreted in its widest possible sense.' This year the Institution had selected Dr. D. T. A. Townend, C.B.E., D.SC., PH.D., D.I.C., HON.M.INST.GAS E., of whom Mr. Melvin remarked: 'Dr. Townend's researches on combustion problems

Above : Birmingham Medallist, Dr. D. T. A. Townend.

Left : Mr. E. Crowther receives the Institution Gold Medal for his paper 'Pressure Storage of Town Gas in a Prepared Underground Cavity.'

Mr. L. P. Ingram and Dr. M. J. F. Olden receiving the Institution Silver Medal for their paper 'The Use of Primary Flash Distillate in Conventional Carbonising Plant'.

Winner of the William Dieterichs Memorial Prize, Mr. J. Ellis. His paper—'Industrial Gas in Birmingham'.

have meant a great deal to our industry. He will long be remembered for his work at Imperial College and for his period as Livesey Professor of Coal Gas and Fuel Industries with Metallurgy in the University of Leeds, where he was in close touch with the gas industry through the Joint Research Committee of the University and the Institution of Gas Engineers and later the Gas Research Board. Now, as Director General of the British Coal Utilisation Research Association, he is closely associated with a wide variety of investigations of direct interest to the gas industry.'

Mr. J. R. Teale receiving the Institution Bronze Medal for his paper 'Clearing the Air'.

The President then made the following awards: *Institution Gold Medal, 1959:* Awarded to E. Crowther, C.B.E. for his paper on ' Pressure Storage of Town Gas in a Prepared Underground Cavity ', read at the 25th Autumn Research Meeting of the Institution on November 18, 1959.

H. E. Jones London Medal, 1959: Awarded to L. P. Ingram, M.B.E., and M. J. F. Olden, B.SC., PH.D., for their paper on ' The Use of Primary Flash Distillate in Conventional Carbonising Plant ', read at a meeting of the

Photographed in the sunshine outside Lauriston Castle are Dr. and Mrs. W. T. K. Braunholtz, the President and Mrs. Melvin, Bailie James McKay and Mrs. KcKay, and Mr. and Mrs. H. S. Cheetham.

South Western Section of the Institution on May 13, 1959.

Institution Bronze Medal: Awarded to J. R. Teale, for his paper on 'Clearing the Air', read at a meeting of the Manchester District Junior Association of Gas Engineers on April 8, 1959.

William Dieterichs Memorial Prize, 1959: Awarded to J. Ellis for his paper on 'Industrial Gas in Birmingham', read at a meeting of the Midland Junior Gas Association on January 20, 1959.

The President's Address

There followed the Presidential Address on which we commented at some length last week, paying particular attention to the section devoted to management. Of this part of the address Mr. J. Hunter-Rioch, in proposing a vote of thanks to the President, said: 'Few will disagree with the urge for a full education, together with the emphasis on the need for the administrator dealing primarily with human beings and getting things done through human beings. Although education in scientific principles is a necessity, it can fall short of the range of qualities required for successful management, and the President's outline of the essentials is one which all who are engaged in the control of industry will wish to examine; to maintain the spirit of an organisation is undoubtedly a function of successful management. While on the one hand, it is true that an understanding of the latest advances and discoveries of science and technology is essential, it is equally true that we must exercise constant vigilance lest the tendencies towards over-specialisation should wreck the high hopes of those younger people whose qualities would match up to the requirements of leadership at the highest level. But there need be no fear of lack of leaders of the requisite calibre, provided we take the necessary steps to that end.'

Seconding the vote of thanks, Mr. L. J. L. Walker, in congratulating Mr. Melvin on the clear and concise manner in which he had put his finger on the salient points affecting the industry, said: 'There is to my mind no doubt at all that, as a nation, we must make in the future the very fullest use of our country's material resources in the form of coal, and in this direction, the gas industry has already made a most valuable contribution, and can, I am convinced, with the increasing application of chemical engineering techniques, contribute still more in the future to this most essential objective. Given, throughout our industry, the clarity of thought and real commonsense in approaching our problems as they arise, which is so evident in our President's Address, the future of the gas industry should be assured, and it will assume its rightful place in the pattern of future energy requirements in Britain.'

There followed the general meeting of the contributors to the Benevolent Fund (report next week), and then we came to the first paper of the meeting. The place of honour went this year to Mr. T. S. Ricketts, Chief Engineer of the Scottish Gas Board, whose paper on 'The Westfield High-pressure Coal Gasification Plant' was not only an excellent paper as such but had the added virtue of describing one of the most interesting plants in Britain today.

Mr. T. S. Ricketts, Chief Engineer of the Scottish Gas Board, presenting his paper on 'The Westfield High - pressure Coal Gasification Plant.'

In his presentation of the paper he pointed out that although the Lurgi gasifier itself might attract the most interest on the works—' these innocent looking vessels each have a normal throughput of 240 tons of coal a day with a maximum throughput of 300 tons '—there were many other items of unusual interest. These the paper described admirably.

' The Lurgi process,' said the author, ' will produce gas at an estimated cost substantially lower than that for gas produced from orthodox carbonisation processes. It does not of course produce coke; but in Scotland we are mindful of the fact that the introduction of smokeless zones may increase the demand for open-fire coke in the future, and we welcome this possibility. If necessary, the production of coke can be increased from the Board's installations of continuous vertical retorts by the usual methods, but the selling price must reflect the true costs of production. Up to the present time the gas industry, by pursuing a policy of coal carbonisation, has " willy-nilly " had to produce coke as a by-product; in short, we have never really been able to control the amount of coke produced, except by the practice of water gas manufacture—a doubtful advantage from the economic standpoint. Now, for the first time, we are about to produce a special smokeless fuel as the main product, to meet a specific demand by means of a carefully balanced production programme based upon a combination of complete gasification and carbonisation methods.'

He pointed out that Westfield was being built to produce cheaper gas of lower toxic and sulphur contents than was possible from conventional production methods. The capacity of the works was not determined by increasing gas demands but by the need to replace existing uneconomic works; consequently the cost of gas produced from Westfield must bear the capital charges on the works to be shut down, and the economics of the scheme must stand or fall on the ability of the Lurgi process to produce gas at a cost, including capital charges, lower than that produced from existing works excluding capital charges. ' Our estimates indicate that this will be achieved.' The author added: ' The ability to distribute non-toxic gas is also a considerable advantage which cannot be expressed accurately in financial terms.'

Mr. Ricketts made it clear that he believes the design of the Lurgi gasifier will continue to improve; his faith in this design of plant is firmly rooted. So apparently is Mr. G. le B. Diamond's; his Lurgi plant at Coleshill will not be completed until 1963 but it may well have the benefit of the improvements which are still taking place in the Lurgi process. Mr. Diamond made it clear that Westfield coal is somewhat better in its sulphur and chlorine content but not so good as Kingsbury in calorific value, ' which is the thing that matters.' His long contribution to the discussion threw some new light on the design of the two plants.

In his characteristically crisp manner, Dr. J. Burns spoke of the production of 500 or 600 B.t.u. gas by the addition of air to a refinery gas or liquid methane or butane as constituting the finest form of seasonal and peak load addition to the Lurgi gas. He wondered why Mr. Ricketts intended to enrich the Lurgi gas only up to 450 B.t.u., because the higher the c.v. of the gas, the cheaper the distribution costs. ' It does not pay any longer to move coal at all,' said Dr. Burns.

Several references were made to the author's reticence concerning the cost of the process. Mr. Sydney Smith explained that the price of coal is confidential, ' but on the basis of a minimum 20-year contract period, it is certainly economic.'

There followed the President's Luncheon, which is reported elsewhere. It was notable for the presence of the Minister of Power who did not make a major speech, for the remarkable, but not unwelcome, brevity of the Lord Provost's response, and for the charming and witty speech of M. Quéret with his reference—more topical than he knew—to the Loch Ness monster.

The afternoon saw a pleasant innovation in the form of a civic garden party in the gracious grounds of

Photographed at the garden party at Lauriston Castle are, left to right: M. P. Mougin, Mme. Mougin, M. Y. Quéret, Mme. Bernard, and Mme. Quéret.

Lauriston Castle where the skirl of pipes and the deft footwork of the dancers delighted the visitors.

When evening brought the company to the Assembly Rooms for the reception and dance it seemed hard to realise that on these premises where the terpsichorean revels showed more than a suspicion of jiving at times, Sir Walter Scott had announced himself as the author of the Waverley Novels.

Oil, architects and industrial gas

Back to business the following morning (June 1) and an opening broadside from Mr. C. Stott, Chief Engineer of the South Eastern Gas Board. His paper 'Gasification at the Isle of Grain' was of great interest and we were grateful to Mr. R. H. Sandford Smith, the Board's Deputy Chairman, for putting the plant into perspective in the framework of the Board's attitude towards gas production. And we rather liked Mr. Francombe's brief contribution in which he spoke of the headaches and sleepless nights ahead for the operators of the plant; as Mr. Stott said, it sounded like going over the top!

A complete change of subject brought us to architecture and a paper on 'The Architect and the Gas Engineer' by Mr. R. Baden Hellard. In a sense this was a misnomer because it was not the gas engineer to whom the author was addressing his remarks so much as the man responsible for getting gas into new houses. His paper deserves careful study and his lively criticism of the industry's methods is worthy of particular attention. Unfortunately his presentation rambled somewhat, but the pace picked up with a first-rate contribution to the discussion by Mr. L. W. Andrew and one of Dr. A. E. Haffner's more surrealist offerings. His interpretation of Stonehenge as evidence of the early Britons' inability to take gasholder construction beyond stage 1 was on a plane far removed from humdrum I.G.E. discussion—and we don't mean Salisbury Plain! The discussion ended with the author encouraging the industry not to have an inferiority complex about gas holders. As if it had!

Industrial gas has its foot firmly wedged in the Institution's door these days, and it was rewarding to hear Mr. A. Higgs, Area Industrial Gas Sales Development Officer of the Scottish Gas Board, break away from the spate of industrial gas research subjects and present a straight-forward paper on 'The Development of the Industrial Gas Load in Scotland.' He pointed out that the industrial field offered the maximum opportunity of expanding gas sales today and advocated a planned approach based on a survey of industry.

In the paper, emphasis was laid on the value from a load-building aspect of a comprehensive board technical advisory service, and loads secured by virtue of this service were described. Cumulative experience tended to indicate that the increase in thermal and production efficiency resulting from conversion of producer gas or solid fuel-fired process plant to town gas was higher on average than might be expected. In two of the examples of conversion from producer gas quoted in the paper, one therm of town gas had served to replace two therms of producer gas, thus rendering gas extremely competitive at the increased price per therm. Reduced maintenance costs on refractories had also resulted in conversion of fuel oil-fired furnaces where restricted combustion chambers were inevitable.

The light fantastic.

'Gas, as an industrial fuel, properly applied, has inherent and exclusive advantages,' said Mr. Higgs. 'New techniques in application are being evolved, and in increasingly competitive markets, it is imperative that the highest thermal and production efficiency be secured in all new installations. Only by so doing can the maximum rate of expansion of sales and our future in the industrial field be assured.'

In his paper he stressed the need for more experienced industrial gas staff, and this theme was continued by most of the contributors to the lively and constructive discussion which followed. The paper brought the various area industrial gas officers out in force and we hope their implied cry for more support fell on sympathetic ears.

The afternoon was devoted to an excellent selection

of visits, chief among which was the Westfield Lurgi plant, described elsewhere in this issue.

Thursday morning brought three papers each in its way important. Subject No. 1 was coke, a product whose future is a matter for speculation. Dr. F. A. Burden, Officer-in-Charge of the Coke Laboratory at Watson House, and D. G. Rose, Coke Manager of the North Thames Gas Board, combined to describe 'Coke in a Changing Market.' They pointed out that the industry could do something really effective to produce what was wanted in controlled amount. Its inability to do so in the past had probably been responsible for an attitude towards quantity and quality which we know only too well. The paper dealt at some length with quantity control, which the authors believed to be vital.

The future of coke

The authors pointed out that the recently published British Standard Specification would no doubt be of considerable assistance, but neither the specification nor the routine testing it demanded was a substitute for eternal vigilance over the physical condition of what was leaving the works. 'More personal interest is displayed at most showrooms over the state of a gas pistol battery costing 4d. than has been displayed at some gasworks over the state of a consignment of coke costing £40. We believe the introduction of brand named fuels has created among those concerned with their manufacture and sale an interest in the products greater than any published specification could possibly engender.

The discussion which followed was a good one, distinguished in particular by the views of a coke oven manager, Mr. W. A. P. Hoskin, and of the Chairman of the Gas Council, Sir Henry Jones. However, it was Mr. G. J. B. Cox who appeared to us to get to grips with the problem. His remarks on approved appliances were very much to the point, and so was his assertion that because the average housewife is drifting away from solid smokeless fuels 'we must do everything within our power to get them marketed, because at least by that means we do get a permanent foothold in the houses.'

From coke we turned to a not entirely unconnected subject—the North Western Gas Board's latest—and last—new carbonising plant. Under the title 'White Lund—Some Aspects of a New Works,' Mr. F. C. Buckley presented an interesting account of this handsome works; both paper and discussion came closer to the 'conventional' I.G.E. paper than any other in a programme which, in keeping with I.G.E. programmes today, tended to explore new technical pastures.

The last paper of the meeting was a commercial one —if the author, Mr. Stirling Everard, will permit a treatise on market research to be so labelled. However, Mr. Everard, who is Manager of the Market Survey Section of the North Thames Gas Board, is not one to swathe his subject in mystery. Perhaps he has done a little market research on I.G.E. papers and discovered (a) that people like a short title which is easy to remember, and (b) that all people want to know about market research is the end product—the conclusions.

Mr. Everard described market research as commercial reconnaissance, and in his paper, 'Live Gas,' he put forward some interesting facts concerning the effect on fuel usage of the increase in the number of working wives—a state of affairs which he interprets as either a disaster or an opportunity. The place of the cooker is declining, but 'to support and supplement the cooker's load, we can offer quick hot water, quick room heating, which is exactly what the wife, returning from factory or office, to prepare an evening meal, wants; moreover, we can keep the food that is to be quickly cooked on the cooker fresh during the day when she is out, in the refrigerator beside the cooker.' The author backed up his picture of the market with the examples of loads now being obtained from consumers in the south of England.

The discussion revealed how seriously the industry is taking the move to hold existing loads and obtain new ones. It is not long ago that many people in the industry considered the possession by a company or a board of a market survey department as a piece of pretentious luxury; today it is to such organisations that the self-same people look for guidance.

However, the discussion revealed that Mr. Everard had not supplied all the answers. Mr. E. Crowther wanted to know if the trend of the electrical domestic cooking load per consumer is similar to that of gas; Mr. G. E. Thomas wanted to know why the author had not paid more attention to the load to be obtained from domestic boilers associated solely with hot water services rather than heating; Mr. J. Castle wanted to know how uneconomic an existing customer can become; and Mr. W. G. Phillips wanted to know whether it had been found in the surveys that there was an adverse public image of gas which was acting as a deterrent, what was the potential for the domestic drying market, the domestic incineration market, and the market for the 'exploded' cooker. In fact Mr. Phillips peppered the author with questions like a machine gun, but the questions were legitimate, essential even, and it is a pity that we must wait for the answers until the author puts them into writing.

The warmth of Scotland

Thus we came to the 'last rites' of the business part of the conference. This year the responsibility for proposing an omnibus vote of thanks to all who had contributed to its success was given to Mr. A. C. Rea, Chairman of the South Western Section, seconded by Mr. R. J. S. Thompson; both gentlemen performed their duties with distinction and, even better, brevity. Dr. Braunholtz responded, modestly maintaining that the architect of the meeting had been the President himself. The President's virtues were elaborated by Mr. H. S. Cheetham and by Mr. J. Grayston. The latter summed it up very neatly: 'We are infinitely indebted to our President for his charm, his grace and his courtesy, which has made each one of us feel that we have had a personal President. He has been truly representative of his race; he has given us the warmth of Scotland and he has given us the charm and the courtesy which will always endear him to us and always help us to give him every good wish for health and happiness, along with his good lady, for many years to come.' And so said all of us.

MINISTER OF STATE AFFIRMS FAITH IN THE SCOTTISH GAS INDUSTRY

President's Luncheon —97th A.G.M.

'THE gas industry is in an interesting condition, for which some may blame the attractions of the electricity industry,' said Lord Craigton, C.B.E., Minister of State, Scottish Office, in proposing the toast 'The Institution of Gas Engineers' at the President's Luncheon, held at the North British Hotel, Edinburgh, on May 31. 'Something has got to happen, and we can only await events.'

He was pointing out that the Institution had come back to Edinburgh at an interesting time in the history of the Scottish gas industry. The Scottish Gas Board had done remarkably well when one considered that only 11 years ago Scotland was one of the problem areas in Britain. Apart from the size of the region, the Board had taken over nearly double the number of manufacturing stations of any other gas board in Britain. The task of co-ordinating so many undertakings and remaining competitive was a tremendous one. The changes made in these ten years had been well nigh revolutionary. Mr. Sydney Smith and his colleagues and staff deserved the warmest congratulations.

Referring to the Lurgi pressure gasification plant at Westfield in Fife, the first of its kind in Britain, and the largest single gas development project in Scotland. Lord Craigton said: 'Westfield will start operating in a few months' time. I am told it will produce 15 mill. cu.ft. of gas a day, and in one year's time this will be doubled. From Westfield, gas will be distributed as far north as Angus and as far south as Ayrshire. The pipeline already laid across the Forth is the longest river-bed crossing by underwater pipe-line ever carried out by any industry in Britain. We should make greater efforts to tell the Scottish people about these things, so that they may know that the Scottish gas industry is confident, up to date, and in trim to tackle its many problems.

Art of salesmanship

'Whatever the prospects, the industry will always have to depend on the art of salesmanship. Here the Board in Scotland have done well, as many husbands know. Gas can be and is being sold. I am prepared to stand up in public and say "sold to me." I am a fan. My wife and I, like millions of families, prefer a gas cooker with its subtle nuances of behaviour that no other form of heating seems to be able to give. The modern gas cookers, and I have had to buy two in the last three years, are objects of the envy of less fortunate housewives. For me the same is true of the gas fire. There is nothing to beat it for those who want flames without fuss—there's a slogan for you!

'It's a good story. It was only in the public mind that your gas was "put in a peep" beside the glamour of the atomic reactor and the giant refinery. Your great technical achievements are beginning to make themselves felt. The gas industry is up against tough competition, and you know it, but we are confident that it has an essential part to play.

'Look at the Gas Council's seven-year plan to invest £370 mill. That means a further exploitation of advanced techniques by forward looking and enthusiastic technical men. And it is to the Institution that we must look for the lead in technical education. It is the Institution which provides the means for discussion, research and the dissemination of information so essential to any profession. Behind you lies nearly a century of successful work—ahead of you lies challenge and opportunity as never before.'

Responding, and proposing the toast of 'The Guests,' the President said that there were, even in Scotland, people who had said they would like to shoot the gas industry down in flames.

'I think we may be sure from the way in which the Minister of State has spoken that those responsible for government decisions in Scotland know exactly what value to put on that sort of talk. Certainly in Britain, and also in many other parts of the world, the gas industry is entering upon a new era of technical advance and wider service. We are discovering new resources and new skills. But sheer novelty has not, of itself, any particular merit; new opportunties call for a special exercise of qualities of judgment and selection. If it is now more generally recognised that the gas industry, far from being outdated, has a quite outstanding and essential part to play in developing our total fuel resources in the most economical way possible, then I believe this is largely due to the informed interest, and the growing informed interest, in its potentialities of men at the heart of affairs.'

Guests welcomed

Among the guests welcomed by the President were Mr. J. Greig Dunbar, Lord Provost of Edinburgh; Mr. Richard Wood, Minister of Power; Sir John Anderson, Secretary of the Scottish Home Department (and representatives from other government departments, including the Department of Health for Scotland, the Ministry of Power, and the Ministry of Labour), Mr. Ronald Parker, Chairman of the Scottish Division of the National Coal Board, together with his Area Scientist, Dr. Chamberlain; Mr. H. D. Greenwood, Assistant Director of Carbonisation, the National Coal Board; Mr. W. Hutton, Deputy Chairman of the South of Scotland Electricity Board; Mr. J. M. Caldwell, Managing Director Scottish Oils Ltd., and Dr. W. B. Peutherer, General Manager, B.P. Refinery (Grangemouth); Mr. D. Radford, Chairman of the British Plastics Federation; Mr. G. W. Chambers, the Coke Oven Managers' Association; Dr. A. C. Monkhouse, President of the Institute of Fuel; Mrs. Gwen Evershed, Chairman of the Women's Gas Federation; Dr. D. T. A. Townend, Director-General of the British Coal Utilisation Research Association; Dr.

F. J. Dent, Director of the Gas Council's Midlands Research Station; Dr. N. F. Astbury, Director of the British Ceramic Research Association, and Mr. F. A. Jackman, President of the National Benzole and Allied Products Association; Sir Henry Jones, Chairman of the Gas Council, Mr. W. K. Hutchison, Deputy Chairman; and Sir Harold Smith, former Chairman of the Gas Council.

M. Y. Quéret, President, Association Technique de l'Industrie du Gaz en France, in response, described the I.G.E. papers as a testimony to the technical progress accomplished each year by the gas industry in the United Kingdom, still in full and prosperous evolution.

Praise of Scotland

Having detailed some of the technical developments achieved, M. Quéret turned to praise of Scotland, 'with its high cliffs and its numerous lakes.' He added: 'But, just like Britanny, Scotland is also a land of legends immortalised by Walter Scott in his romantic tales—we arrived at Waverley Station! In the dreaming hours, I love to be reminded of the old tale of the monsters appearing in your lakes, like Loch Ness. Is it impossible to imagine that we may suddenly discover that these horrible monsters are nothing other than submarine plastic gas pipe-lines carrying natural gas from the depths of your lakes to burn in torches on your faraway moors?'

After the Minister of Power, Mr. Richard Wood, had said a few words, Mr. Sydney Smith, Chairman of the Scottish Gas Board, proposed the toast of 'The President.' 'I have had other opportunities to speak of Mr. Melvin's past history within the gas industry and of his close association for many years with the City of Edinburgh,' he said, 'but it is quite safe to say that he is one of the most travelled Presidents in the performance of his duties of office that the Institution has ever known. During the past year, he has visited seven District Sections of the Institution in England and Wales, two affiliated Associations in Ireland and Scotland, eight Junior Associations in the United Kingdom, and three foreign associations on the Continent of Europe. All these in addition to meetings of the Council and Committees of the Institution in London, and not once has he missed a meeting of the Scottish Gas Board or of the Executive Committee of the Board. Indeed, he has carried out the onerous duties of his office in the way that we would expect of him. A remarkable performance!'

Messrs. A. G. C. Riley (South Eastern), G. A. Vernon (William Sugg & Co. Ltd.), J. L. Stokes (South Eastern) and C. T. C. Woodall (Radiation Group).

Messrs. B. W. Dawkins (North Thames), N. Bateman and S. Dobb (North Eastern), L. Price (South Western), and A. J. L. Gamper (South Eastern).

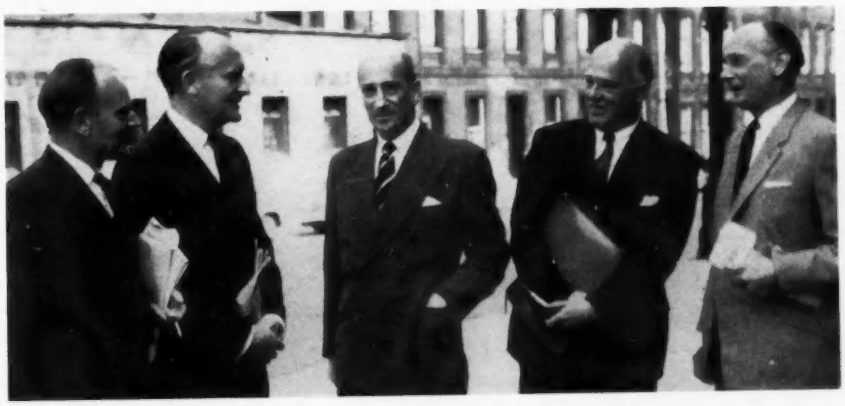
Messrs. L. Eales, R. H. Harris (Edinburgh), R. Raine and J. J. Massey (E. Pass & Co. Ltd.) and J. Spencer (Clay Cross Iron & Foundries Ltd).

Our camera outside the Usher Hall

Messrs. G. E. Thomas (Eastern), A. L. West (Parkinson-Cowan). E. Bates and F. W. Pickering, (East Midlands).

Messrs. G. Stenhouse and R. J. Baines (Henry Balfour & Co. Ltd.), J. Perks (Stoves Ltd.), F. K. Thomas (Limerick), A. H. Small and Dr. S. W. Lohrisch Henry Balfour & Co. Ltd.).

Messrs. C. A. Macleod (R. & A. Main Ltd.), R. H. Bone (Scottish), Sam Hall (Thos. Glover & Co. Ltd.), and W. J. Parsons (West Midlands).



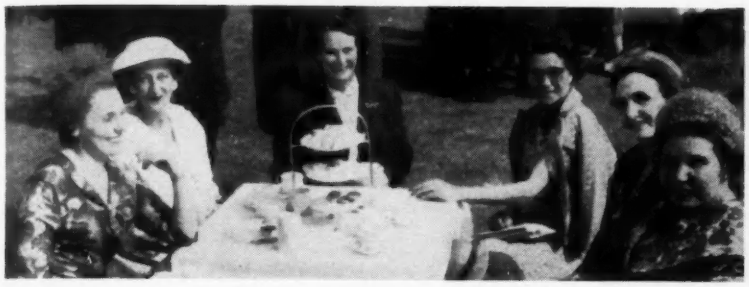
Ascot on parade. Messrs. G. E. Jeffs, B. Coates, G. M. Behr, J. C. Backhurst and G. N. Michie.

GARDEN PARTY

The **Gas Journal** camera joins the Institution at Lauriston Castle

Mr. E. Crowther and Mr. A. F. Oatley, with (extreme left) Mrs. Crowther and Mrs. Oatley

Mr. and Mrs. H. E. Dyble



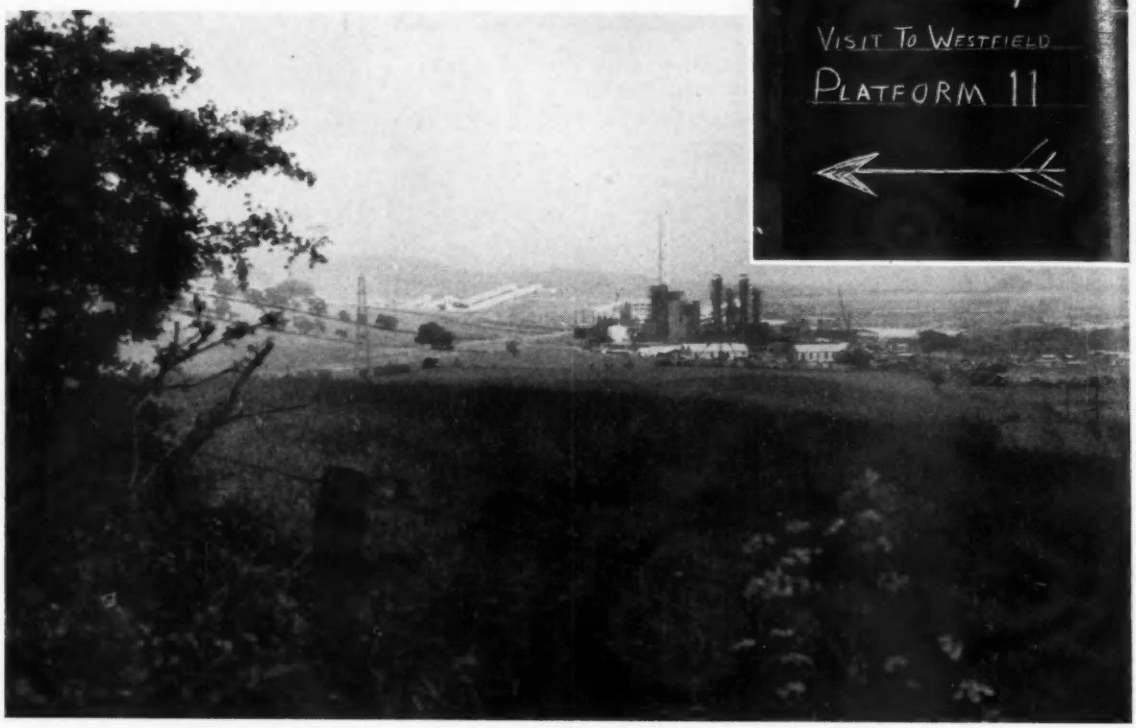
Mrs. Averill, Mrs. Paterson, Mrs. Smith, Mrs. Fletcher, Mrs. Higgs and Mrs. McFadyen.

Mr. and Mrs. W. Morland Fox.

Mrs. G. A. Vernon (left) with Mr. and Mrs. E. Aspinall and Mr. and Mrs. J. Powdrill

Amateur photographers were in full cry after the Scottish dancers. Here is Mr. I. M. Perl in action.

The I.G.E. delegates visit Westfield



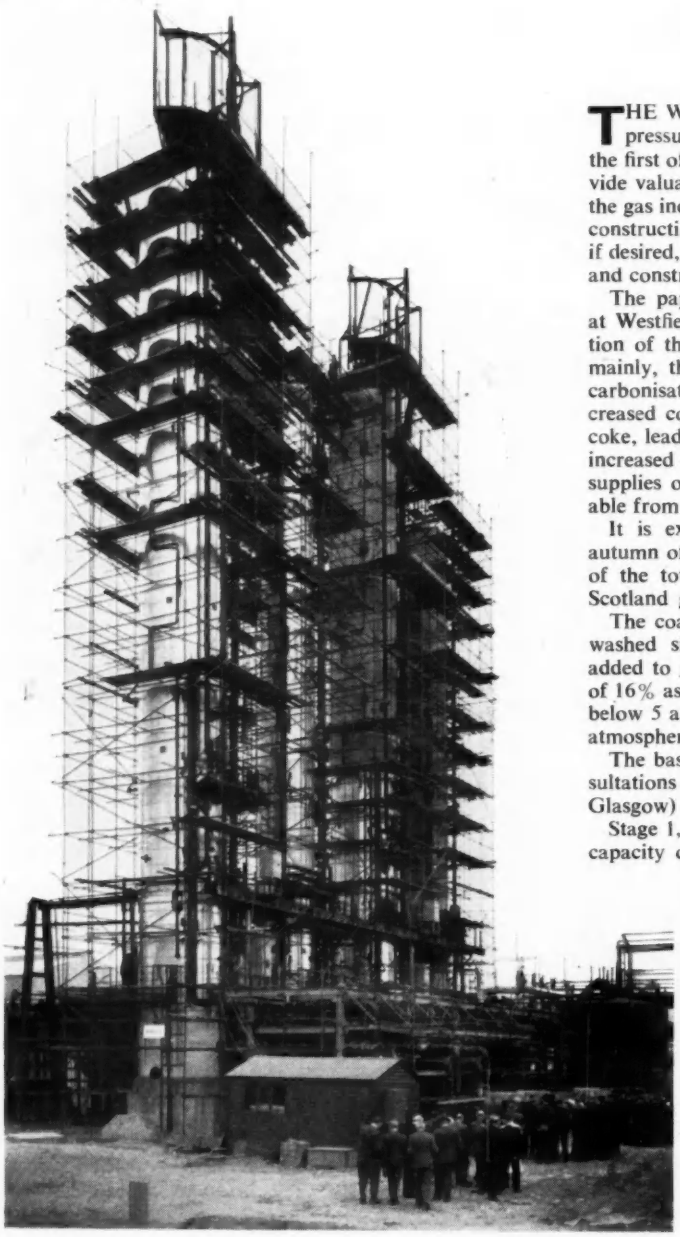
One of the most popular visits was to the Scottish Gas Board's Westfield works which is in an advanced stage of construction. The visitors saw the three Lurgi pressure gasifiers, each with a nominal capacity of 7·5 mill. cu. ft. per day, two oxygen plants, each capable of producing 100 tons per day of oxygen, boiler house, hot potassium carbonate wet-purification plant for the removal of carbon dioxide and hydrogen sulphide (two streams, each having a capacity of 15 mill. cu. ft. per day of gas), and high-pressure tower purifiers for removing final traces of hydrogen sulphide.

ABOVE : Mr. Sydney Smith, Chairman of the Scottish Gas Board (fifth from left), and his Chief Engineer, Mr. T. S. Ricketts (fourth from right) play host to the Chairman of the Gas Council, Sir Henry Jones (second from right), the Deputy Chairman, Mr. W. K. Hutchison (sixth from right) at Westfield. Also in the picture are four area board Chairmen—Mr. G. le B. Diamond (West Midlands), Mr. R. S. Johnson (East Midlands), Mr. E. Crowther (Northern) and Mr. T. Mervyn Jones (Wales).

ABOVE : Mr. T. C. Battersby and Mr. J. Hunter-Rioch (Eastern) chat with Mr. J. Simpson (Woodall-Duckham Construction Co. Ltd.).

LEFT : Dr. A. E. Haffner (Southern), Mr. David Elgin (Scottish), Mr. Stirling Everard (North Thames)—and author of the paper 'Live Gas'—and Mr. R. Gillespie.

The Westfield high-pressure coal gasification plant



By T. S. RICKETTS, M.Inst.Gas E.

THE Westfield works is based on the principle of high-pressure gasification of coal by the Lurgi process and is the first of its kind in Britain. The Westfield works will provide valuable experience to the Scottish Gas Board and to the gas industry in general. 'Every lesson learned during the construction and operation of the works will be available, if desired, for the benefit of those concerned with the design and construction of other Lurgi plants in the future.'

The paper describes the plant now nearing completion at Westfield and sets out the reasons leading to the selection of this process under present conditions. These are, mainly, the poor return from the coke produced by the carbonisation of most Scottish coals together with the increased costs of carbonising coals; the difficulty of selling coke, leading to the increased use of c.w.g. with attendant increased cost of gas production. The Lurgi plant requires supplies of suitable non-caking coals, and these are available from an adjacent open-cast mine.

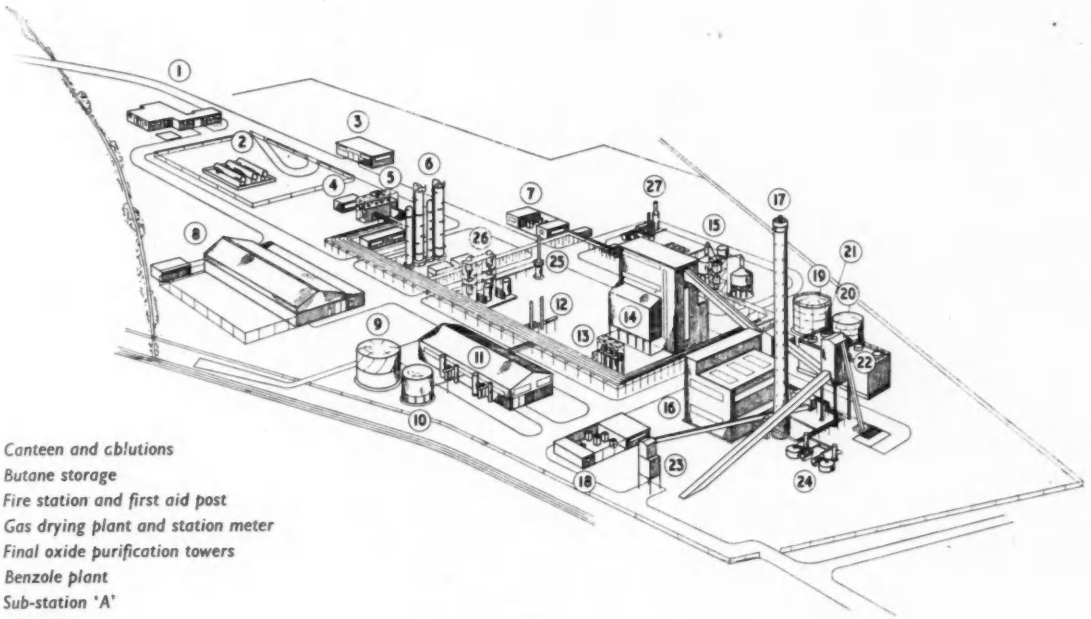
It is expected that gasmaking will commence in the autumn of this year and that Lurgi gas will constitute 26% of the total requirements in future years of the Central Scotland gas grid.

The coal will be sized from ½ in. to 1 in., consisting of washed singles to which washery middlings have been added to give not more than 30% inerts with a maximum of 16% ash in the final mixture. The agglutinating value is below 5 and the ash fusion temperature in a semi-reducing atmosphere lies between 1,450 and 1,550°C.

The basis of design (prepared after discussions and consultations held with the main contractor, Humphreys & Glasgow) is set out in detail.

Stage 1, to be completed by the end of 1960, is to have a capacity of 15 mill. cu.ft. of gas per day. Stage 2, now to be completed by the end of 1961, will add a further 15 mill. cu.ft. per day. The nominal gas producing capacity of a Lurgi gasifier of 9 ft. diameter is of the order of 8 to 9 mill. cu.ft. per day of purified gas. Four gasifiers would therefore be needed to produce 30 mill. cu.ft. per day, or five if one is to be held in reserve, but this number has been reduced to four because of the necessity to add 5 to 7 mill. cu.ft. per day of diluent gas (N_2 or CO_2) plus enriching gas to produce a mixture of town gas quality. Three gasifiers will be installed in Stage 1 and the fourth in Stage 2.

Mr. Ricketts is Chief Engineer of the Scottish Gas Board.



1 Canteen and ablutions
2 Butane storage
3 Fire station and first aid post
4 Gas drying plant and station meter
5 Final oxide purification towers
6 Benzole plant
7 Sub-station 'A'
8 Workshop
9 Nitrogen holder
10 Liquid oxygen storage
11 Oxygen plant
12 Benzole absorbers
13 Lurgi after-coolers
14 Lurgi house
15 By-products area
16 Boiler house
17 Chimney
18 Sub-station 'B'
19 Lock gasholder
20 Effluent storage tank
21 Cooling towers
22 Coal screening plant
23 Ash bunker
24 Acid gas disposal plant
25 Heater (for carbon monoxide conversion plant)
26 Carbon monoxide conversion plant
27 Ammonia treatment plant

Fig. 1—Artist's impression of Westfield works.

Load factor is to be 90% during Stage 1 and 83% during Stage 2.

The carbon-monoxide content of Lurgi gas is 27 to 28% and this was to be reduced by catalytic conversion with steam to 8%, later revised to 5% or less.

The calorific value of purified Lurgi gas without CO conversion was expected to be about 410 B.t.u. per cu.ft. After CO conversion and removal of CO_2 followed by addition of N_2 to restore the specific gravity to about 0.5, the c.v. would be 310 B.t.u. per cu.ft. During Stage 1 the gas is to be enriched by butane and the final values will be sp.gr. 0.5 and c.v. 450 B.t.u. per cu.ft.

The amount of oxygen required in the gasification process is considerable. At full production it was estimated that nearly 200 tons per day would be required. For security reasons two plants each of 100 tons per day capacity are to be installed. 'Cost of production falls sharply as the size of oxygen plant increases.'

The Lurgi gasifier is shown in section in Fig. 2.

The internal diameter of the gasifier is 9 ft. The working pressure is 355 lb. per sq.in. High pressure requirements are 65 lb. per 1,000 cu.ft. of purified gas produced or 1.08 lb. per lb. of fuel gasified while 3.71 cu.ft. of oxygen are required per lb. of fuel gasified. Fuel gasified per 1,000 cu.ft. of purified gas (assuming 2% CO_2 in purified gas but excluding added butane and nitrogen) is stated at 60.1 lb.

A cross section of the Lurgi house is shown in outline in Fig. 3.

A simplified flow diagram of the whole plant is shown in Fig. 4.

Gas leaving the gasifiers at temperatures 400° to 500°C. is immediately washed in a 'quench cooler,' tar water being sprayed into the gas at this point, reducing the temperature to about 196°C. at which the gas passes through a waste-heat boiler which it leaves at about 168°C. recovering heat in 0.86 lb. steam at 55 lb. per sq.in. per lb. of fuel gasified. Gas from the waste-heat boilers passes to two stages of further coolers.

The tar and liquor systems are described.

High pressure steam is produced in three Babcock & Wilcox boilers of the Bi-drum type with Ignafluid grates, each capable of producing 45,000 lb. per hour of steam at 450 lb. per sq. in. pressure and a temperature up to 385°C. The maximum high pressure steam requirements are calculated to be 110,000 lb. per hour excluding electricity generation. The Ignafluid grate is capable of burning fine coal (below $\frac{1}{8}$ in. with preferably a large proportion below $\frac{1}{8}$ in.) with high ash content.

The Lurgi process operates on the principle of the gasification of coal in steam and oxygen at high pressure and more than 100 tons per day of oxygen at a pressure of 29 atmospheres are required for this plant on full load. After extensive investigation the Linde-Frankl liquid pump type was chosen. It operates on the principle of the separation of liquefied air, by fractionation and rectification, into its components oxygen and nitrogen, finally producing gaseous oxygen at around 426 lb. per sq.in. pressure. The Tonnox plants installed at Westfield are described. Liquid oxygen is stored in a heavily insulated vessel to the capacity of 560 tons at −183°C.

Carbon monoxide conversion in a plant designed and constructed by Humphreys & Glasgow is effected by converting to hydrogen and carbon dioxide by reaction with

steam over a catalyst. It is anticipated that CO will be reduced to 6.5% in this process leaving 36.8% CO_2 to be removed in the Benfield plant (described in the paper)—a 'hot potassium carbonate process whereby simultaneous removal of CO_2 and H_2S takes place.'

To reduce H_2S to statutory requirements the Bischoff system of purification under pressure, designed and constructed by Newton Chambers, is installed. This plant is also described. Sulphur is recovered by catalytic oxidation of H_2S followed by the Claus Kiln catalytic process—the whole designed and constructed by Simon-Carves. The problem of disposal of the acid gases was solved by the installation of a special 'three-in-one' chimney which is described—built by The Tileman Company.

The gas quality control and the high-pressure grid mains system are described and discussed.

As it is not possible to disclose the cost of the basic raw material the economics of the Lurgi process are referred to only in general terms.

The process operates at about 65% overall efficiency; thus producing twice the number of gaseous therms per ton of coal produced in carbonisation. The return from the by-products is not sufficiently high to be a major factor

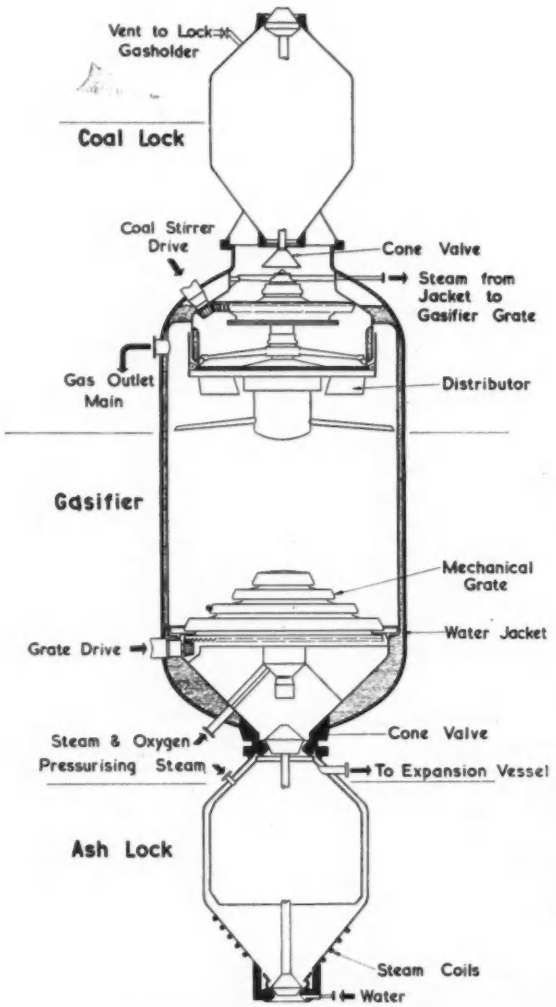


Fig. 2—Diagram of Lurgi gasifier.

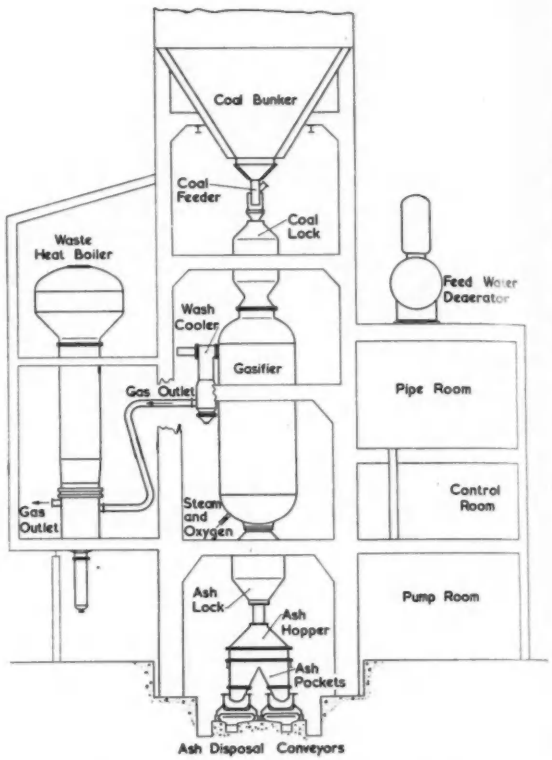


Fig. 3—Cross-section through Lurgi gasifier house.

in reducing cost, but the coal is of poor quality, small in size and 'much cheaper' than carbonisation coal. The cost of oxygen production is high and large quantities of high pressure steam are used in the process.

Capital cost is stated to be equivalent to 2.9d. per therm when amortised over the 20-year period, which is the term of the contract for the supply of coal.

Purified gas is put into the grid at 250 lb. per sq.in. which is conservatively estimated to represent a saving of 0.8d. per therm compared with the cost of compression.

'It is sincerely believed that it (Westfield) represents the best available answer to the rising costs that have beset the gas industry since the end of the second world war.'

DISCUSSION

Mr. Sydney Smith, C.B.E. (Chairman, Scottish Gas Board): The Board's decision in February, 1958, to go ahead with the installation of a Lurgi pressure-gasification plant in two stages, each of 15 mill. cu.ft. a day capacity with the probability of a third stage of similar capacity, finally rested, of course, on the economics of the proposals; and these in turn rested on the price of coal on the basis of a long-term contract. Originally, the coal was to be run-of-mine, unwashed, sized 3 in. and downwards.

You may think it odd that no price is mentioned in the paper. The reason for this is that the price is confidential; but, on the basis of a minimum 20-year contract period, it is certainly economic. Twenty years is the estimated life of the opencast workings and, because of this, the capital costs of the whole works will be amortised over the same period, although the coal contract allows for: '. . . 20 years or the life of the mine whichever is the longer.'

The Westfield project is a striking example of successful

co-operation between two nationalised industries, and I have nothing but praise for the Opencast Executive of the National Coal Board through the person of Mr. R. H. Thomas.

Our original conception was to build the works on a 30-acre open site at Skeddoway, which had vested in the Board. This site is situated about 4¾ miles from the opencast mine; it has excellent rail facilities and, being scheduled as operational land and sterilised against underground workings, it seemed ideal for the purpose until we investigated transport costs for coal coming in and ash going out. The minimum costs which we were able to negotiate with the Transport Commission would have meant an annual charge of about £80,000, or at least £1.6 mill. over 20 years; and it was obvious that we must look for an alternative.

In this we were fortunate in purchasing from the National Coal Board for a very reasonable sum, the present 45-acre site which is adjoining the site of the opencast workings. Before purchase, the site was fully investigated, as described in the paper, and it was thus possible to save transport costs by arranging to bring in coal direct from the Coal Board's storage bunkers by belt conveyor.

Site clearance began in October, 1958, and the first stage of production was programmed to begin in the late autumn of 1960; and I am glad to say that this part of the programme is smack on schedule. The second stage was programmed to come into production in the late autumn of 1962 but, having decided to marry the two stages as far as possible during the construction of stage one, the second stage is now expected to be in production in the late autumn of 1961; 12 months ahead of the original programme.

During the intervening period, preliminary operations on the coal face were started and 75,000 tons were taken out to obtain operational experience. The coal lies in 14 leaves (or layers) down to a depth of between 750 and 800 ft. The leaves vary in quality and are interspaced with fireclay in some places and with shale in others. As a result of the preliminary working, and following evidence of spontaneous combustion in isolated spots on the coal face, the Opencast Executive reached the conclusion that they might have difficulty in meeting quality guarantees for the run-of-mine coal to our works.

There was, perhaps, another consideration: The estimated output of the mine is 1 mill. tons a year; and our annual requirements, if and when Stage III comes into being, will be nearly half this quantity taking into account electricity generation. A washery to deal with the full output of the mine had been installed at a cost of over £800,000; and if half the output of the mine had to bypass the washery, the answer was obvious.

So we were pressed to consider the use of washed and sized coal, and this we agreed to do provided that the price, having regard to better quality, would give us a similar bargain to the original price negotiated for run-of-mine coal.

Eventually, a solution was found in the provision of a washed-coal and middlings mixture, sized 1 in. to ½ in., with an ash content of 16% and a moisture content of 14% as compared with 25% ash and 16% moisture for the run-of-mine coal in the original contract; and at a satisfactory price.

This meant, of course, the replanning of coal handling: Dispensing with the belt conveyor from the opencast storage bunkers, and handling coal by railway wagons from the adjacent washery into an underground hopper, and thence by belt conveyor to the Lurgi house. Again, the Opencast Executive was helpful, and we were able to reach agreement on transport, shunting and weighing facilities, use of sidings and emptying of wagons; a guarantee of continuity of supply and a constant reserve of 3,000 tons of wagon storage to be called upon as required. The use of a washed-coal mixture of constant size will also, of course, give us obvious operational advantages.

Although I began by saying that the final decision to go ahead with the project finally rested on the economics of the proposals, it meant that we should be breaking entirely new ground so far as experience in this country was concerned; and it was necessary, therefore, to investigate the practicalities of the process.

As Mr. Ricketts has stated the Lurgi Company had already proved from a 200-ton sample of the opencast coal sent over to Germany in 1952, that the coal could be

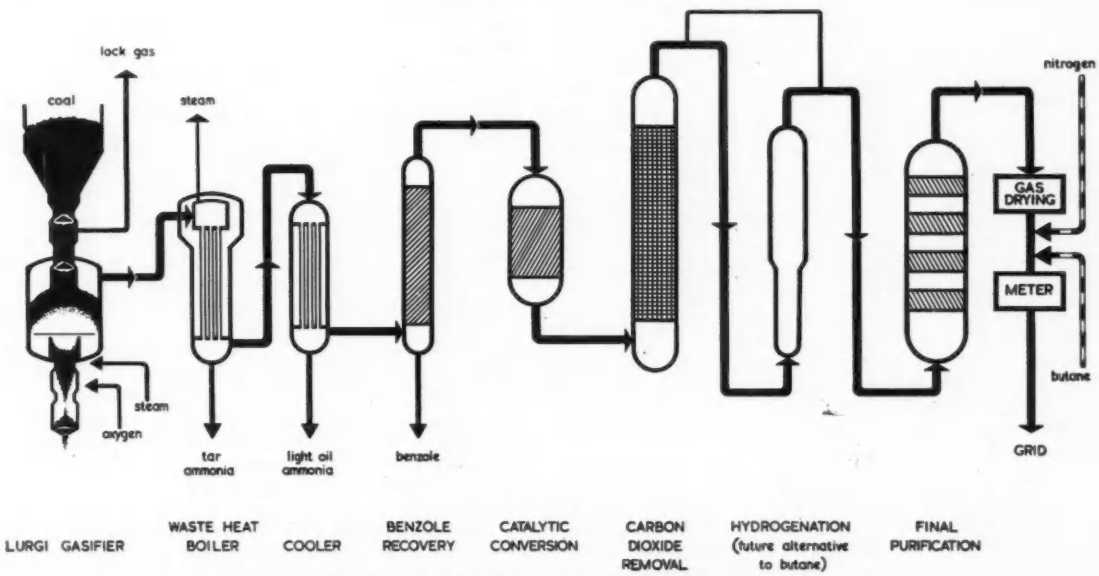


Fig. 4—Simplified flow diagram of Westfield works.

successfully handled by the pressure-gasification process. Talks were, therefore, instituted in Frankfurt with the Lurgi Company, and visits paid to the Dorsten works of Ruhrgas where a Lurgi plant with a capacity of 60 mill. cu.ft. a day had been in successful operation since 1956, gasifying bituminous coal with somewhat similar characteristics to the Westfield opencast coal. The tragedy is, of course, that the Westfield gasification project was not pressed forward following the successful tests in 1952.

It was also necessary to gain first-hand knowledge of operational experience further afield, and visits have been made to the Sasol works of the South African Coal, Oil and Gas Corporation, where a Lurgi plant with an output of 100 mill. cu.ft. of gas a day handles bituminous coal, again somewhat similar in characteristics to Westfield opencast coal; and to the Morwell works of the Gas and Fuel Corporation of Victoria, Australia, where a Lurgi plant similar in capacity to our own is now successfully gasifying briquetted brown coal, and sitting on top of a coal reserve confidently estimated at not less than 3,000 mill. tons.

At all these places, we gained a wealth of knowledge of operational and maintenance techniques, as a result of which design modifications have been introduced into the Westfield plant. I cannot speak too highly of the tremendous assistance given to us in every case, towards the avoidance of initial teething troubles and operational difficulties to which, I am quite sure, we would otherwise have fallen heir; or of the warm welcome which awaited us everywhere, and of the willingness of everyone to open the floodgates of experience.

During our visits to Frankfurt we were able, eventually, to persuade the Lurgi Company to permit the fabrication of the fourth gasifier to take place in the United Kingdom, and this is being undertaken by the Power-Gas Corporation Ltd. at their Stockton works, by arrangement with Humphreys & Glasgow Ltd.

Problem of Recruitment

One of our problems has been, and still is, the recruitment and training of staff, a process which started about 12 months ago, and which is still proceeding. All the process techniques involved, and many of the maintenance problems, are, of course, entirely new to the gas industry in Britain; but recruitment is almost complete and we expect to finish training in good time. And again we have been fortunate in the good offices of Mr. Etienne Rousseau, Managing Director of Sasol, who has offered the loan of specialist staff, should the need arise. We shall also have the services of specialist staff from the Lurgi Company and from Humphreys & Glasgow Ltd. As things stand, as of today, it is expected that commissioning will commence with the Ignafluid boiler plant at the end of July or the beginning of August, and of other ancillaries thereafter until the gasifiers come into operation towards the end of December. Gas should be feeding into the grid about the turn of the year.

Time will not permit other than a passing reference to the grid, which will operate at an initial pressure of about 250 p.s.i.g. It will stretch over the Tay Bridge to Dundee and Montrose in the north-east, through the central belt of Scotland, across the Forth on the bed of the river, to Coatbridge, Glasgow and Edinburgh, and on to the Ayrshire coast in the south-west. Mainlaying and testing are nearly six months ahead of schedule and the work will be completed with time to spare.

Mr. G. le B. Diamond (Chairman, West Midlands Gas Board): Sir Harold Smith announced the intention of the West Midlands Board to install a Lurgi plant as long ago as the autumn of 1952. Thanks to what Sir Arthur Smout described as 'wanton obstruction' our plant will not be in production until 1963. Scotland have therefore beaten us to the post and we extend to the Scottish Gas Board our warm and hearty congratulations.

Perhaps, however, what we have lost in not being able to give our consumers a better and marginally cheaper gas, we have gained by the improvements that have taken place in the Lurgi process over the years. We are grateful in particular to Dr. Weittenhiller at Dorsten, Dr. Andrews of Morwell, Australia, and Mr. Rousseau of Sasol, and their staffs, for much help and encouragement. Instead, therefore, of having a plant with a gross production efficiency of around 75%, we and the Scottish Gas Board have every hope of securing an overall efficiency, including the thermal value of the products, such as tar, oil and phenol, of 85%; that is to say gross and not net. This remarkable increase has come about as a result of clear and logical engineering thinking rather than from the research worker studying the chemical and thermodynamic conditions of gasification under pressure, although our own Dr. Dent was the first to show that the synthesis of methane took place in the producer.

Politicians' false assumption

Now a word or two about coal. There has been some loose talk about the suitability of the Lurgi plant for gasification of low grade coal. It was too readily assumed by politicians and others that the plant would gasify any kind of low grade rubbish. On the other hand, there have lately been some misinformed suggestions that the Lurgi plant is particularly sensitive and selective in its coal requirements. The truth lies mid-way, and Mr. Ricketts gives an outline of the specification at the top of [p. 25]. It is of interest to compare the approximate analysis of the Kingsbury coal that we intend to use in the West Midlands with the analysis given in [Table 3 on p. 10]. In the case of Kingsbury the moisture is 11%, the ash 12%, fixed carbon 44.3%, volatile 32.7%, gross c.v. 10,800 B.t.u. per lb. against Westfield 8,613 B.t.u. per lb.; sulphur 2.4% against Westfield 1.30%; chlorine .3% against Westfield .013%.

It will thus be seen that the Westfield coal is somewhat better in its sulphur and chlorine content but not so good as Kingsbury in calorific value, which is the thing that matters.

The size range of the particles of coal is important and Lurgi specify that the ratio should be of the order of 5:1 and the ash fusion temperature definitely over 1,200°C. The Lurgi generator will gasify a very wide range of high ash bearing coals provided that the material selected is within the fusion range. It is, however, a question of economics. More oxygen and more steam are required for certain coals and, if too high a price has had to be paid for the coal in the first instance, there is no available margin to spend on the extra steam and oxygen if the gas is to be sold in competition with gases produced in conventional plant.

Chlorine corrosion

No mention is made in Mr. Rickett's paper of precautions against chlorine corrosion, and presumably this is because the chlorine content of the Westfield coal is very low. On the other hand, this form of corrosion has been a serious problem and has been overcome by cladding all the exposed surfaces in the generator and on the stirrer with stainless steel which is applied by means of welding in closely spaced runs.

I noticed that the Scottish Gas Board are to benefit from the work done by Dr. Weittenhiller in changing the water-cooled grates to steam cooling from the annular boiler.

Before this innovation was brought about, very large quantities of water were evaporated in the producer because it was not possible to keep the grates water-tight. In one calculation I saw that no less than 5 tons of uncontrolled water per hour were entering the gasifier in this manner. The steam cooled grate has brought about a marked increase in the efficiency of the generator and, of course, has materially lowered the quantity of effluent to be disposed.

Maximum generator outputs

When we commenced studying the Lurgi plant the maximum daily output of a generator was 5 mill. cu.ft. per day of purified gas. It is now claimed at Dorsten that they can produce 14 mill. cu.ft. of gas per day in a single gasifier but this is not a true comparison, for the figure of 14 mill. includes the natural gas (CH_4) added for enrichment). They are actually carburetting CO_2 but, nevertheless, this is a spectacular figure for it represents the output of a coke oven plant carbonising 1,100 tons of dry coal per day.

Until experience has been gained by some period of actual working, we think the number of generators should be such that there is one gasifier in reserve against emergencies while one is under repair or maintenance. With only one spare generator a rather heavy risk is taken when major repairs are required, unless the load can be picked up elsewhere. Coal and ash lock hoppers, for instance have to be changed from time to time and, while this is done on some installations with 400 p.s.i. pressure standing on the cone valves, it is not a practice which would commend itself in the British Isles.

We have given much thought to the spacing between the generators and have been influenced by the apparent difficulty of removing generator bases and other heavy parts from the building. In consequence, we have specified a spacing of 20 ft. between the centre lines of the generators to be installed at Coleshill.

Removing hydrogen sulphide

In the planning of a high-pressure gasification plant there is no part of it which requires more close attention and investigation than the purification plant. There is a number of proved methods of removing hydrogen sulphide and the CO_2 from high pressure gas, but most of them suffer from some disadvantage when the time comes to apply them to a particular installation. The details given given by Mr. Ricketts on [pp. 42 to 52] give some indication of the thorough way the Scottish Gas Board have investigated this problem. The one satisfaction of all the proven processes is that they will work and provide a gas of high purity. The economics, however, vary between one and another quite considerably, but no figures are given on the cost of the Benfield process at Westfield so that no useful comment can be made. The Alkazid process, which is well tried, uses an amino acid for the absorption of almost the whole of the H_2S, the final traces being removed with tower purifiers. The lye is expensive and parts of the plant are constructed in a special metal to withstand corrosion. The CO_2 can be removed by the Vetro-coke process in which hot potassium carbonate is used. Since no H_2S contaminates the CO_2, it can be purified by the use of activated carbon to absolute purity for use in the food industry. The market in solid CO_2 is not saturated and, with the growing movement of frozen foods to all parts of the country, there is something to be said for this process. It could, in favourable circumstances, bring in a revenue amounting to approximately ¼d. a therm.

We are, however, deeply interested in the improved and simplified Rectisol plant for the West Midlands project but a final decision has not yet been taken.

Naturally that part of the paper dealing with the oxygen plant has been of intense interest since we also have inspected and studied plant on the site on the Continent and in South Africa. It could not be expected that a paper of this kind would go into every detail, but I could have wished that there was more information about the safety arrangements that the Scottish Board have provided. For example, in that part of the system conveying gaseous oxygen from the evaporator to the generators, will the mains be of stainless steel throughout or are they providing firebreaks of stainless steel in a mild steel run? The Scottish Gas Board have come to the same views that we have arrived at independently with regard to the compression of oxygen in the liquid state and much the same kind of thought has entered into our calculations about storage.

No mention has been made of the noise made by the change-over valves in the regenerators of an oxygen plant. The release of pressure can at times be very objectionable and I should like to know whether the Scottish Gas Board have given any attention to this matter or whether, as the plant is situated right out in the country, it is of no great consequence. In an area like the Midlands, noise of this description could not be tolerated. Several solutions are available: One of them is to silence the exhaust by means of expansion chambers and baffles, although even then the noise is said to be at a level of over 70 decibels. The other method is to enclose the whole of the plant in buildings which have received acoustic treatment.

Disposing of nitrogen

The manufacture of O_2 automatically provides large quantities of nitrogen. Initially this will, no doubt, be used as a ready source of piped inert gas for use in many parts of the plant. No doubt, as the Lurgi process develops, further and larger quantities of nitrogen are available, an economic outlet may possibly be found. It is already being purchased by another company at Sasolburg, South Africa, for making sulphate of ammonia.

Steam for process work and electricity for power have a very considerable influence on the gas production costs. In addition, it is essential, as stated by Mr. Ricketts, to provide firm, reliable and flexible services. The proposals go a very long way to meeting these requirements.

The Scottish Board are to be congratulated on their introduction of the Ignafluid system which is to be used with Babcock and Wilcox Bi-drum type boilers in order to obtain an economic and reliable steam raising service from low-grade fuel. Details of the grate and combustion system are indeed interesting, particularly the dust recycling principle which, incidentally, was originally developed for coke-dust burning boilers.

The electrical system has obviously been laid out to give extreme flexibility and reliability, and this has been achieved by means of an extensive high tension system. It is to be noted, however, that as a consequence the transformer capacity to maximum demand ratio is of the order of 5. Similarly, the corresponding utilisation figure of high tension switchgear is somewhat less than 300 kVA. per unit.

High and low pressure steam

The figures given in [Table 9] for estimated power consumption are interesting, and it would be helpful if Mr. Ricketts could draw up a similar consumption table for steam, both for the high and low pressure systems.

With the West Midlands project, we propose to integrate both the high and low pressure steam production units into a common back pressure and condensing electric generating system. In order to achieve optimum efficiency it will be necessary to operate 'near critical' on high pressure P.F. boilers which will be supplemented by a single

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Q What's the difference between meat cooked on an open-roasting spit and meat cooked in an oven?

A You'd soon **taste** the difference! Cooking in an enclosed oven is **baking**. Baking destroys the succulent **true** flavour of meat, poultry and game. You can only **roast** on an open spit. That's why only Cannon can give you "Real Roasting".

Q **Real** Roasting?

A Yes. The SuperChef roasts with two kinds of heat:—radiant heat quickly seals in the meat's natural juices while infra-red heat roasts the meat evenly, right through—and you can roast to the **exact** degree preferred.

Q Does spit roasted meat "splatter"?

A Very little. The roasting spit turns **away** from you and any "splattering" is directed against the back plate. In fact most of the surface juices roll around the meat so that it literally bastes itself.

Q Will it roast a large joint?

A Perfectly! The SuperChef is designed to cater for a large family. A sirloin of beef, leg of pork, shoulder of lamb, chicken, turkey, ham, game birds—the SuperChef roasts them all to a turn. And in a matter of seconds the Roasting Spit can be folded away and the Versatile, Large-Capacity Foldaway Grill is ready for use.

Q Is it **simple** to use?

A Yes, and it is quicker, cleaner and far superior to oven cooking. Because it is **real** roasting it retains all the **natural** juices and flavour of the joint.

Q Is it easy to clean?

A The Cannon open-roasting spit is wipe-over cleaned in less than a minute.

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"This is the first and only domestic cooker on which meat can be **roasted.** As more people savour the delights of real roasting, I am certain that an ever-increasing demand for this Cannon Cooker is bound to follow. Cannon **is** Britain's First **Complete** Gas Cooker."

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stage of reheat so as to obtain an increase of about 10% in both entropy and heat availability.

The working pressure will be of the order of 2,500 p.s.i. at a temperature of 950°F. A transformer capacity ratio not exceeding 2 with a corresponding switchgear utilisation figure of 4,000 kVA. is confidently anticipated. It will, of course, be readily appreciated that these conditions relate to a plant which, in the first stage, is larger than the Westfield project and which, in its final form, will be utilising nearly ½ mill. lb. of high pressure steam per hour and 40 MW. of electric power.

Dr. J. Burns (Deputy Chairman, North Thames Gas Board): The Lurgi process is acknowledged to be the most economical, successful process for the conversion of the carbon and hydrogen in coal, the hydrogen and oxygen in steam, to a mixture of hydrogen and carbon monoxide. It is a process to which the gas industry has to pay the greatest attention, to improve that conversion. The Lurgi process gives us a very great opportunity of providing essentially purer gas with the calorific value required.

The importance of being dry

What is also very important is the fact that the gas from the Lurgi process should be completely dry, completely free from moisture, under conditions of pressure. That gives us the opportunities of adding air to a gas which we never had before. Air is the very cheapest thing that it is possible to get, and if you can visualise the production of a gas of 500 or 600 B.t.u. per cu.ft. by the addition of air to a refinery gas, to a liquid methane or butane, that is the finest form of seasonal and peak load addition to the Lurgi gas. But the gas, in the first place, must be completely dry. Lurgi gas can be produced from 350 B.t.u. up to 420 B.t.u. per cu.ft. with only marginal variations in efficiency, but maximum efficiency of 370 B.t.u. per cu.ft. requires the addition of 100-B.t.u. per cu.ft. enrichment, and the source of this enrichment gas is very important. We notice in Mr. Rickett's paper that they intend to enrich this gas up to 450. I would ask Mr. Ricketts why? Why do you stop at 450 B.t.u. per cu.ft. because the higher the c.v. of the gas, the cheaper the distribution costs associated with it, and undoubtedly the trend is towards higher c.v. I would have said that now is the right time to change the calorific value of the gas to 500. I would say that it is possible to match up the remaining gas to the richer Lurgi gas.

It is noted that the Scottish Board may have their plant right close to the coalfields. This exemplifies clearly the fact that it does not pay any longer to move coal at all and that will be the position of gasification plants up and down the country in the future. But when one carries out a survey, or looks round the country as a whole, one finds that the places where there are very large concentrations of coal suitable for complete gasification under pressure are not very plentiful. One will find that the very large concentrations of suitable coal have already been booked for electricity, and electricity is booking more and more every day, and the other situations show only relatively small concentrations of coal. There are some, however, where one can get coal up to the extent of about 1 mill. tons per annum, and that allows a Lurgi plant of approximately 120 mill. cu.ft. per day.

The size of Lurgi plants

One of the essentials of the Lurgi plant is that it should be big in size. There is, in fact, so far as we know, no limit at all to the size of a Lurgi plant, and we see clearly, from the present forms of plant that we have got at the present time with the size of 30 mill. cu.ft. per day and upwards, the improvement in overhead costs is quite large. In the case of the Lurgi process, the plants can go on increasing in size, certainly up to 120 million cu.ft. per day, and you can go on a good long way beyond that and still not reach the optimum in overhead costs.

What do we do with small concentrations of coal which exist up and down the country, which are booked for gasification only? A small amount of coal does not do with Lurgi plant. It is not economic to carry the coal about the countryside. It does seem that it would be preferable to gasify these small quantities of coal in plant which do not require oxygen, and to have this gasification gas purified from sulphuretted hydrogen but under low pressure to a central collecting point where the gas could be pruned to its proper quality and enriched to the proper calorific value.

That takes us to the point of what we are going to use in the future for enrichment gas. It does appear, on present showing, that imported methane, imported propane/butane are likely to be the most suitable forms of enrichment gas. In fact, I think it is going to be clear that the Lurgi process will have to work very hard to keep its place in comparison with production from imported methane and propane/butane. At the present time, it is likely that the enrichment gas arriving in the Midlands could be cheaper than Lurgi gas, and then the cynic will say 'Why bother with the Lurgi gas now?' The answer is that you have got to break down the methane and propane/butane to 500-B.t.u. gas, and the process of breaking down does cost money.

Mr. G. Gresle Farthing (Deputy Chairman and Managing Director of Humphreys & Glasgow Ltd.): It will be obvious from the author's paper that a project such as Westfield did not just start without a very great deal of preparatory study.

Speaking from first-hand experience, it has involved the creation of a strong team of specialists in the various fields involved, and detailed study of the proven processes available, not only in the United Kingdom and Europe but also in the United States and elsewhere in the world.

Years of costly endeavour

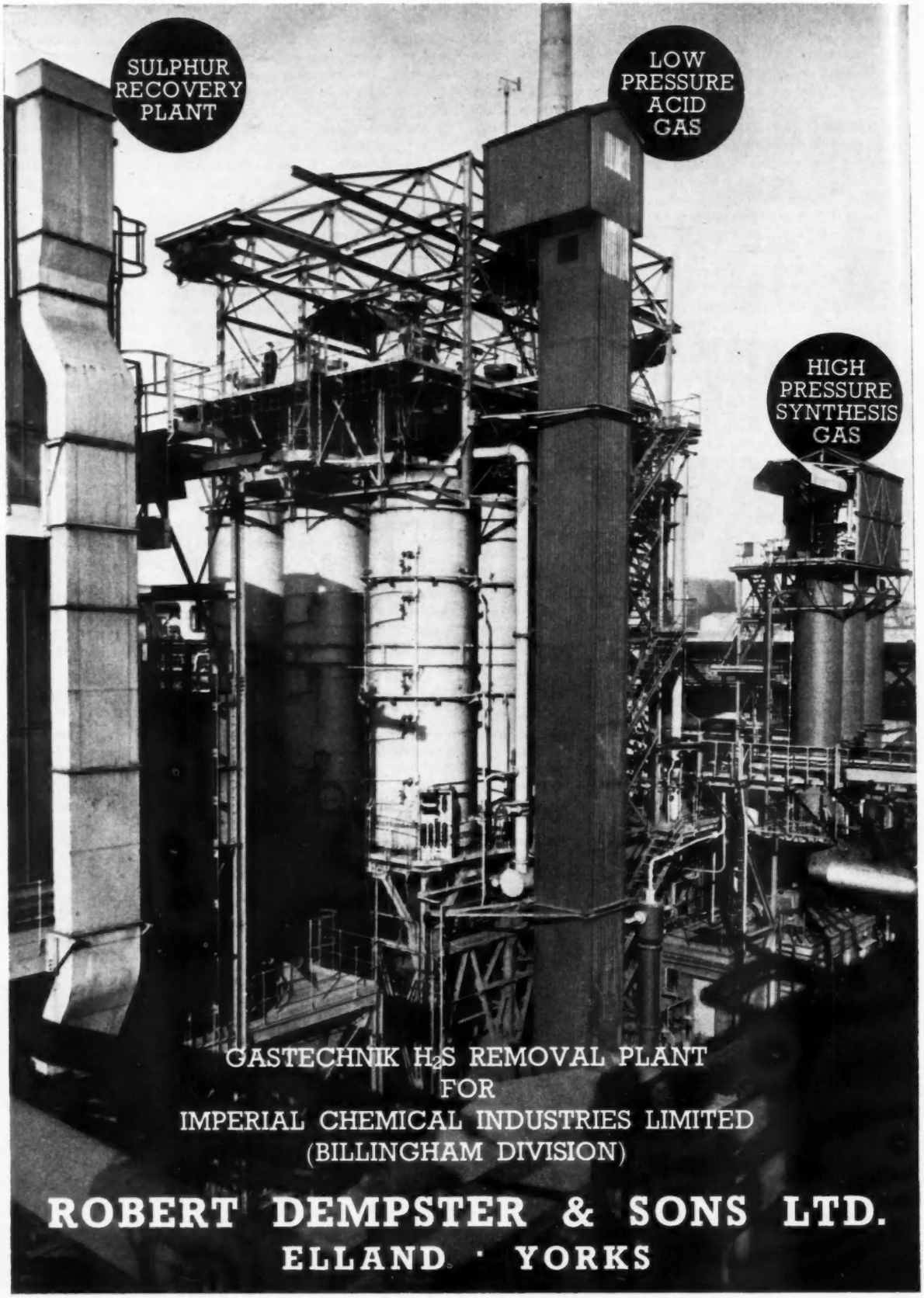
The assessment of the potential of new developments and equating the cost of such improvements as they offer—all this has covered a period of many years of costly endeavour. Still further improvements can often be visualised at the end of any study for a particular design group, but in hard practice the time-table set for completion of the project must dictate an end-point for study if costs and dates are to be maintained.

Cheap and abundant coal and low-cost enrichment are at the heart of the Westfield project, and the basic thoughts on which we worked could not be better expressed than in the Presidential Address of Dr. Burns at the 95th Annual General Meeting in London, in May, 1958. The particular point I want to stress is 'plants for the gasification of coal should be placed as near as possible to the pithead.' This is exactly what has been done at Westfield.

I find it difficult to accept the siting of a works of this or greater magnitude where the coal price is loaded by transport charges well in excess of the cost of distribution of gas by pipeline.

I would like also to underline the necessity for thinking big when considering such new production works. The scale of operation has a very marked effect on cost of gas production—a works of 100 mill. cu.ft. per day is the order of magnitude one should have as a target.

Modelling techniques were used both for overall layout and for the piping design of complex areas. The pictures on [pp. 44 to 45] are good illustrations of this. These models are most helpful in obtaining at an early stage full agreement and understanding between all concerned,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thus subsequent interference is reduced to a minimum and smooth working achieved in both the office and the field.

It will be of interest that all pipework for this project has been fully fabricated on site, and the arrangements for this can be seen during the works visit.

The basic plant for this project is the Lurgi gasifier, but as the author points out, this part of the installation represents only a fraction of the total cost of the works. The building of such plant into a comprehensive whole to give a final gas of the correct characteristics with low CO content, and at the lowest cost attainable when all the particular circumstances are taken into account, is the real problem to be solved. At Westfield, I believe this has been achieved.

The fourth gasifier

The fourth Lurgi gasifier for Westfield is now being fabricated in the United Kingdom. This is the first one ever to be made outside Germany with the agreement and co-operation of Lurgi, and represents an appreciable saving in import duty, while ensuring the 'know-how' is immediately available for emergency as has always been expected by the industry in the past.

I would support strongly the author's comments on oxygen plant; close consultation with the specialists in such plant is necessary. The author is wise in reminding us to maintain a careful balance to ensure that observation of safety regulations does not develop into a welter of harassing rules resulting in hindrance to general progress.

The author mentioned that the actual capital cost will be close to the original estimate. I think it is fair to say also that, as is so often the corollary, the construction programme is also proceeding on schedule.

Finally, 'availability of production' at Westfield is a 'must,' thus all reasonable costs have been incurred to this end, but the mentality of 'braces. belt and adhesive tape' has been avoided.

Mr. H. D. Greenwood: The development of complete gasification of coal in this or other processes is, as you will appreciate, a matter of considerable interest to the National Coal Board. Mr. Sydney Smith has given you a good account of the rather special circumstances at Westfield. What I want to say about coal relates more particularly to deep-mined coal for other or future Lurgi plants. It is clearly important to establish a range of coal that can be used in the Lurgi process. On this subject there seems little reliable data. Within limits, size by itself is not a serious problem, nor are, within limits, moisture and ash; but ash fusibility and the caking index of the coal cannot easily be changed. The operating conditions can be modified, within limits, to meet a range of ash fusibility and coals could be blended to decrease fusibility. The standard Lurgi generator incorporates a stirrer sytem to deal with a limited degree of caking in the coal, but there appears to be no very definite information as to where this limit lies.

It has been generally considered that fine coal must be excluded from the feed to the generator and that coal throughput will be considerably reduced if there is any coal below ¼-in. size. Here I find conflicting views. It has been stated that coal down to $\frac{3}{32}$ in. can be used satisfactorily. At Westfield, the minimum size is given as ½ in. It has been suggested that there might be considerable advantage in separating the coal into two size fractions, using the two fractions in separate generators. Clearly, coal throughput is quite closely related to size. In general, the wider the range of coal which can be used, the larger is likely to be the number of suitable sites that can be found. Dr. Burns has drawn your attention to some difficulty in finding sites.

I suggest that it is important for both the coal and gas industries that there should be adequate study of these problems. Actually, some study has already been taking place. In the Coal Board, some study has been made of the possible colliery sites where Lurgi plants might be erected. Coals suitable for the process on the present specification are mainly in the Midlands, and since design studies have shown that there can be an appreciable economy with larger plants, our studies have included supplying up to 1 mill. tons per annum to a single plant. The ideal solution would be to erect the plant at a colliery which produced the required tonnage of smalls, but hardly any collieries operate in this way, and it may be necessary to import smalls from an adjacent colliery; or to crush some of the larger sizes. Both methods involve extra costs.

With regard to the cost of the process, on which Mr. Rickett, I notice, is somewhat reticent, I think the important question is whether gas can be made by the Lurgi process at a cost which is sufficiently below current gas-making costs to allow it to be sold at a price which will be low enough to secure increased gas sales. Is the cost of Lurgi gas, as currently estimated, low enough to achieve this objective; if not what can be done to reduce production costs? Coal constitutes about 45% of the cost (the coal used for steam raising included) and I think it would be unwise to assume that much cheaper coal than that now proposed for Lurgi plants can be obtained.

Capital charges and throughput

The next largest item in the cost sheet is capital charges and any possible ways of increasing throughput are therefore important. Dr. Dent and his colleagues have published some results on operating a Lurgi with ash removal as molten slag. Operating in this way allows perhaps twice the throughput per generator, and, at the same time, larger generators may be used to increase throughput still further. It has been estimated that there may be a definite economy, possibly of more than 1d. a therm, on the cost of crude gas with the slagging type of generator, and work on the development of this should, I suggest, be accelerated as a matter of urgency.

If the Lurgi gas is not treated to convert the CO and to remove the CO_2, there is a considerable saving in cost, possibly as much as 2d. a therm or more. A crude gas of that type would be quite suitable for many industrial processes, which today use oil, or in the past used producer gas. Why should not the gas industry supply a crude industrial gas in suitable areas of heavy industrial concentration, provided the price was competitive?

Estimates I have seen for a crude gas of that type do suggest that the price would be competitive with any other type of fuel. The Lurgi plant of the future might well supply different types of gas for different purposes; it might have an output of 200 to 200 mill. cu.ft. per day; and to avoid coal transport costs, there might be slagging generators at a number of adjacent pits drawing oxygen from a central point and feeding crude gas to a central treatment plant. That sounds a long way ahead but I suggest that it is not entirely fantastic.

Pointer to improvements

We in the coal industry hope that the experience at Westfield will establish the suitability of the process for a fairly wide range of British coals, and will point the way to further improvements on the process, so that gas production costs can be reduced to the level at which a large scale extension of gas production by these means can be made financially attractive. In all these developments, the N.C.B. will be happy to co-operate as they have in their new venture in Scotland.

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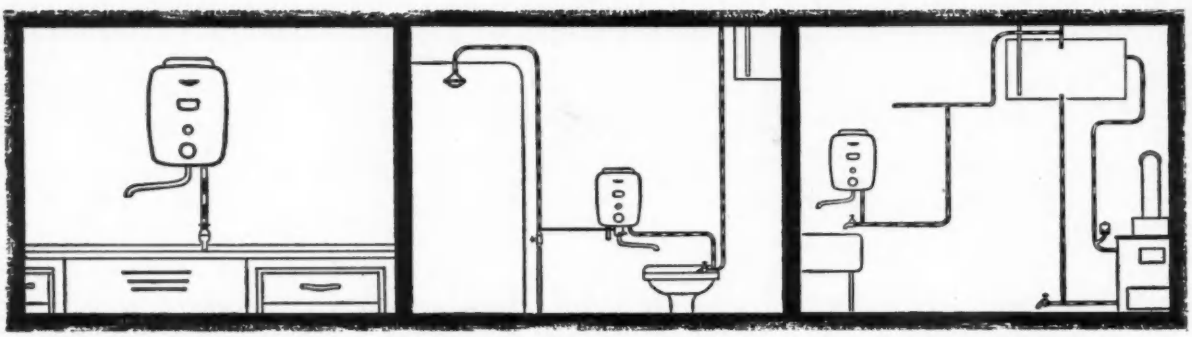

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Visits

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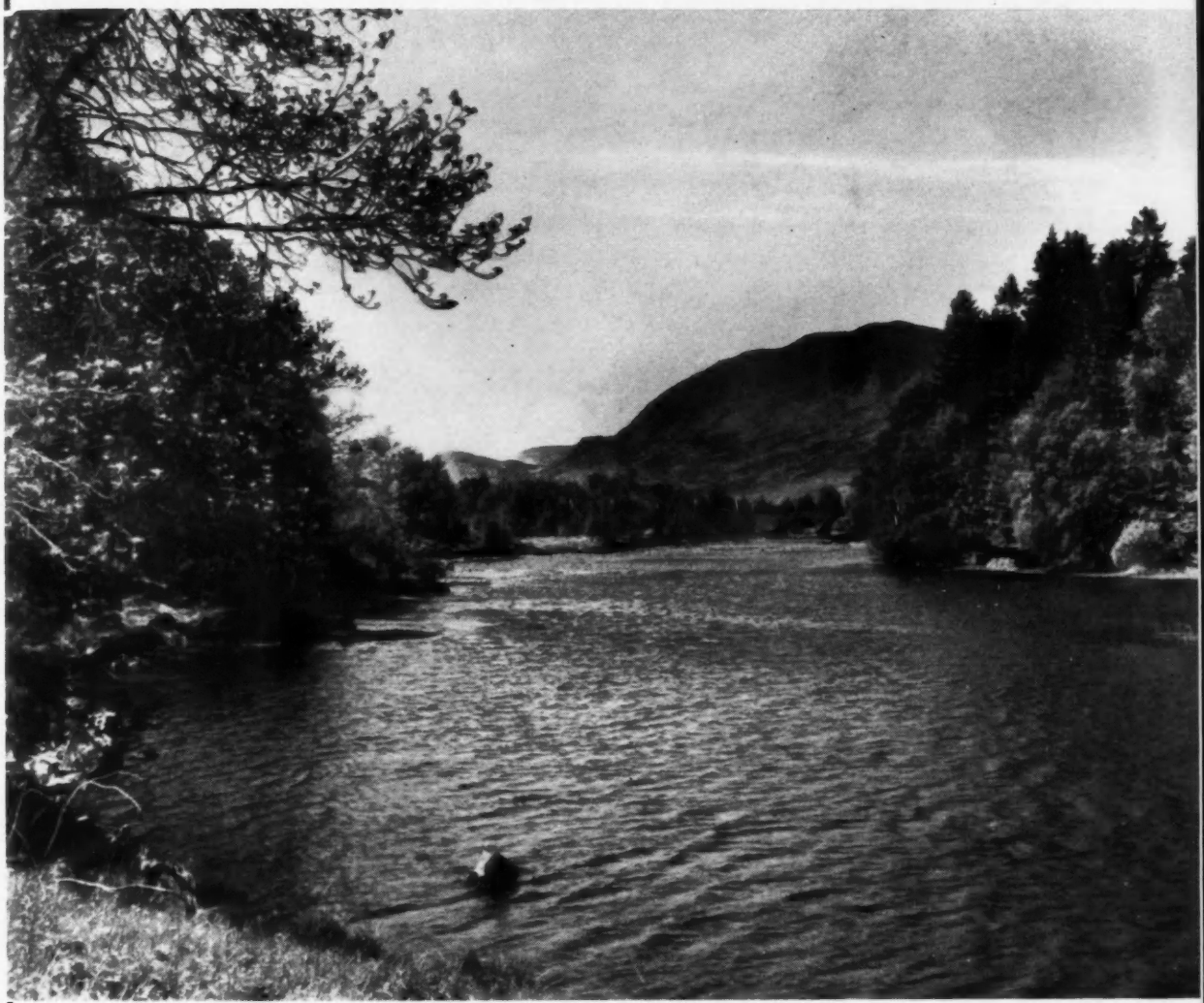


During the 97th A.G.M. of the I.G.E. in Edinburgh visits were paid to the Westfield and Granton works of the Scottish Gas Board ; the research centre and Dury foundry of Henry Balfour Ltd. ; the B.P. Grangemouth refinery ; the Falkirk works of R. & A. Main Ltd. ; the Clydesdale works and British works of Stewarts & Lloyds Ltd. ; and to Burton's Gold Medal Biscuits Ltd. There was also a day sight-seeing tour of Loch Lomond and the Trossachs.

Scotland's showpiece—the Westfield plant

BRITAIN'S first ever Lurgi high-pressure complete gasification plant is rapidly taking shape on a 43-acre site at Westfield on the Fife-Kinross county boundary. The plant, which will make use of low rank non-caking coal, marks the beginning of a new era for the gas industry in Scotland.

The erection of the works by Humphreys & Glasgow, is being carried out in two stages. Stage one will be completed by the autumn when the plant will be producing 15 mill. cu.ft. of gas daily. Stage two will take a further two years to complete. The total estimated cost of the plant is £6.6 mill., and with the associated grid system, the overall total cost will be nearly £8.5 mill. which represents by far the largest single project ever undertaken by the gas industry in Scotland. The new plant represents a remarkable development in fuel technology, since it produces gas by chemical processes and practice from a type of coal completely unsuitable for carbonisation by conventional means.

By the end of last year contracts to a total value of £1,830,333 had been placed which included oxygen plant, high-pressure tower purifiers and steam-raising plant, all of which will be the first of their kind to be incorporated into gas-producing plant in Britain.

Three gasifiers, 28 ft. long, with an outside diameter of 9 ft. 10 in. and weighing 50 tons are now installed, and two will work together on the completion of the first stage of construction at the end of this year to produce 15 mill. cu.ft. of gas a day. The first gasifier arrived at Leith by sea. All are housed vertically on a massive reinforced concrete base. When in operation each gasifier will consume 240 tons of coal, 60 tons of oxygen and 220 tons of steam daily.

British Oxygen Linde Ltd. are responsible for the oxygen plant which will produce a bulk supply by the Tonnox system. At Westfield there will be storage for 550 tons of liquid oxygen. The Benfield plant for the removal of carbon dioxide and hydrogen sulphide is visually one of the most striking parts of the plant, consisting of tall steel cylinders like the cracking towers of an oil refinery.

Two IGNA-fluid stoker-fired boilers on the site are the first to operate in Great Britain and their builders—Babcock & Wilcox Ltd.—and their French associates have had considerable experience of their well-tried process.

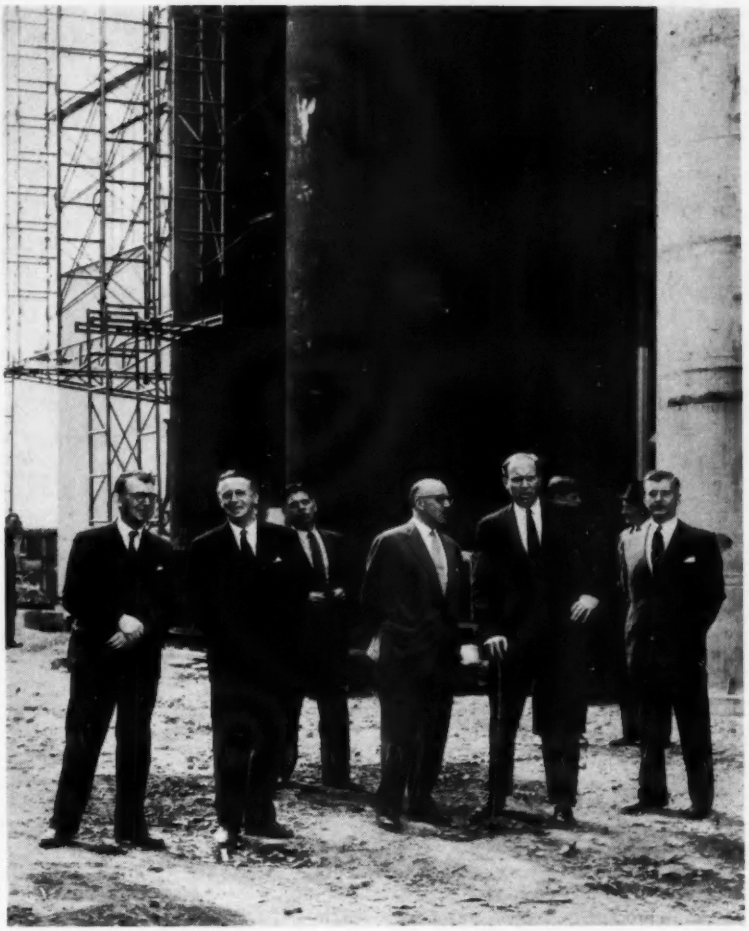
The new Vischoff type of tower purifier going into use for the first time in Britain is another important feature of the plant. The purifiers will have a daily capacity of 30 mill. cu.ft. of gas.

With a capacity of over 35 mill. cu.ft. of gas a day the Granton works of the Scottish Gas Board, which occupy 106½ acres of ground on the shores of the

JANUARY 1959

A general view of the 43-acre site of the Westfield Lurgi plant showing foundation work in progress after site clearance had been completed.

Mr. Richard Wood, Minister of Power, inspected Britain's first Lurgi pressure-gasification plant, which the Scottish Gas Board are building at Westfield, Fife on May 30. Picture shows, left to right: Mr. D. C. Elgin, Technical Officer, Scottish Gas Board; Mr. G. Gresle Farthing, Deputy Chairman and Managing Director, Humphreys & Glasgow Ltd. (main contractors for the works); Mr. E. Eggins, Works Engineer at Westfield; Mr. Sydney Smith, Chairman of the Scottish Gas Board; the Minister of Power; and Mr. T. S. Ricketts, Chief Engineer, the Scottish Gas Board.

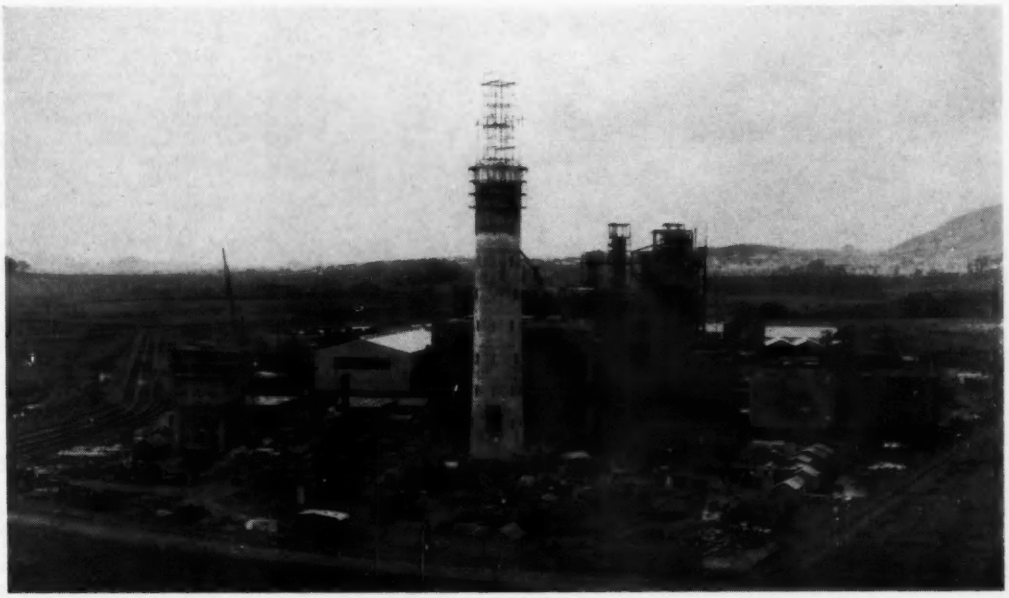


Firth of Forth, is the biggest single gas-producing unit in Scotland.

The gas-making plant comprises seven benches of Woodall-Duckham continuous vertical retorts, two of which were installed in 1954 and are equipped with mechanical producers, Drummond dust extraction plant and Sturtevant vacuum cleaning plant; three Humphreys & Glasgow carburetted water gas sets utilising virgin naphtha for enrichment and reforming; producer gas sets for dilution purposes; and, more recently, butane enrichment plant for direct injection into the purified gas stream.

Other features of the works plant include modern gas cooling and wet purification plant, the recently commissioned Balfour-Lecocq tower purifier installation, coke preparation and loading plants, and the M.A.N. waterless holder. From the top of the last mentioned on a clear day, a fine view of the City of Edinburgh and the Forth Estuary with the distant Highland ranges can be seen.

APRIL 1960



The £6.6 mill. high-pressure complete-gasification plant takes shape. Gas production is scheduled to start in the autumn.

An oil worker at the B P Grangemouth refinery.

Grangemouth expanding fast

THE growing post-war demand for oil products made it necessary for the Grangemouth refinery of the British Petroleum Co. Ltd., to be substantially enlarged, and an expansion project, involving the erection of new plant and the re-modelling of existing units, began in 1949. This whole project was completed in 1954 and raised the refinery's capacity to 2.2 mill. tons a year. Further expansion, completed in 1959, has raised

Gas pipe by the mile comes from Stewarts & Lloyds

The rotary forge mill at Stewarts & Lloyds' Clydesdale factory.

THE Clydesdale steel and tube works at Bellshill and the British tube works at Coatbridge each demonstrate one of the main methods of making steel tubes. At Clydesdale are produced seamless tubes made from solid ingots of steel and used largely by the oil industry; the British works are concerned mainly with the manufacture of large diameter welded pipes made from steel plates for the bulk conveyance of water, gas and sewage, although certain sizes are used by the oil industry.

The Clydesdale works are situated at Mossend, in the midst of the Lanarkshire coal fields, about 12 miles east of Glasgow and next to the main railway line between Carlisle and Perth.

Increased output needed

The major influence on Clydesdale's post-war expansion has been the need for increased output to meet the oil companies' increasing demand. This meant virtually the establishment of a new integrated works and today Clydesdale consists of an open hearth steel plant and two rotary forge tube plants principally concerned with the production of oil well casing in the range

the refinery's capacity to more than 3 mill. tons a year.

Among the refinery's products are BP petrol, liquid petroleum gas, diesel oil, vaporising oil, kerosine and fuel oils. Feedstock for petroleum chemical plants which have been built in the vicinity by various companies, in some of which BP has an interest, is also produced.

The most important units in the refinery are the distillation units, through which all the crude oil must pass. In the units the incoming crude oil is first passed in tubes through a furnace where it is heated to about 650 degrees Fahrenheit and then fed through a series of distillation towers. In the main distillation tower benzine, naphtha, kerosine, light gas oil, heavy gas oil and residual fuel oil are separated at various levels in descending order.

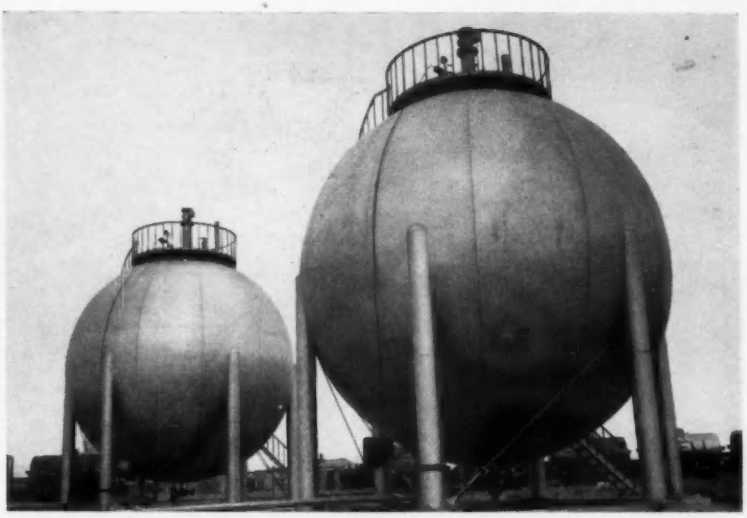
Residual oil from the distillation units is further distilled in the vacuum distillation unit to produce a feedstock for the catalytic cracker, and heavy residual oil for fuel oil blending.

The catalytic cracker converts feedstock from the vacuum unit into high-grade lighter products—including BP Super and BP Super Plus premium-grade petrols. This is done by bringing the feedstock into contact with a powdered catalyst—either natural clay or a synthetic equivalent.

Two gases (known as C_3 and C_4) from the catalytic cracker are fed into the catalytic polymerisation unit after being purified by the removal of hydrogen sulphide and other sulphur compounds. The C_4 gas is treated in a butane polymer unit and converted into high octane polymer, an important component for raising the quality of motor spirit. The C_3 gas is converted into tetramer and piped to the plant of British Hydrocarbon Chemicals Ltd., where it is used in the manufacture of chemicals.

Hydrogen sulphide extracted from the catalytic cracker gas is fed to the sulphur production plant from where finished

Continued on p. 486.



Two of the four 25-ft. diameter Horton-spheres used for the storage of butane gas at Grangemouth.

4½ in. to 9⅝ in. outside diameter and line pipe in the range 4½ in. to 18 in. outside diameter.

The works now cover 124 acres, employ 2,500 people, including 350 staff, and have a capacity of 200,000 to 240,000 tons of tube per annum.

The steel plant has an ingot capacity of approximately 300,000 tons per annum. Most of this steel is required for the two tube plants and the remainder is transferred to other similar plants within Stewarts & Lloyds.

Bevelled end pipe

The No. 1 rotary forge tube plant, which was brought into operation in 1948, was designed essentially to produce bevelled end oil line pipe. This is the largest seamless tube mill in Britain and covers the size range 8⅝ in. to 18 in. o/d., in thicknesses from .219 in. upwards. It has a rated capacity of 80,000 to 100,000 tons per annum, depending on the size of pipe being rolled.

Immediately after rolling the tube is cut by hot saw and the individual lengths are passed through a sizing mill prior to ejection on to a chain type conveyor. When cold, the tubes are straightened and thereafter pass through a series of finishing and inspection operations, during which quality control checks are carried out to ensure conformity in all respects with the specifications concerned.

It is interesting to note the consumption in this works of town gas relative to other fuels, as shown by the following figures for annual consumption:—

Town gas	250 mill. cu.ft.
Coal	130,000 tons
Oil	1,310,000 gal.
Tar fuel	1,710,000 gal.

The British tube works, which is near Coatbridge, Lanarkshire, was founded in 1899, and is one of a number of the company's works in that area.

Covering an area of 30 acres, the works employs 1,000 people, including 150 staff, and has an output of 30,000 tons of pipe per annum.

All pipes at the British works are made from plates which, after preparation of the edges to be welded, are rolled into circular form and then welded by one of two processes, hydraulic lap weld or electric fusion weld. On completion of welding those pipes produced by the hydraulic weld process are rounded and straightened and all are faced at ends.

The pipes are then ready for passing to the finishing departments—straight pipes for end sizing, the forming of ends for special joints, hydraulic pressure testing, etc., while pipes to be fabricated into 'specials' or other products pass to the departments concerned.

Protections department

With the completion of all finishing operations pipes and specials are then transferred to the protections department for the application of the service protections usually called for in the class of work concerned.

Most pipes and specials receive some form of service protection before despatch, depending upon the service for which they are required and the conditions under which they are to operate.

These are applied in a specialised protections department in which approximately 1,500 tons of bitumen are used annually.

Pipes for gas mains have the bore coated with red lead. The effect of this is to reduce considerably the rust dust nuisance that can occur when the pipe is in service. These pipes are usually protected externally with woven glass reinforced sheathing.

The casting shop at Stewarts & Lloyds' Clydesdale factory.

Opened last year, the £150,000 extension to Ferranti's Crewe Toll works in Edinburgh produces inertial navigation instruments.

Ferranti—Edinburgh's largest employer

THE Edinburgh factory of Ferranti Ltd., one of the oldest electrical firms in Britain, was opened in 1943 for the manufacture of gyro gunsights. At the end of the war the factory's activities were given a new direction to include electronic equipment, and since that time expansion has been continuous. In 1952, additional premises were occupied at Dundee and Granton and an apprentice school was established at Leith which now provides training for both craft and student apprentices.

With the continued growth of the company, additional space had to be found in the Edinburgh area and two mansion houses overlooking the Firth of Forth were taken over. Craigroyston House is now used as the centre for research and development on computer control of machine tools, and Muirhouse accommodates the company's film, photographic and printing units as well as a service school which provides courses of instruction on the use and maintenance of Ferranti manufactured equipment such as gunsights, radar and machine tool control systems.

Radar system development

The company's radar laboratory is principally employed in the development of radar systems for the three services and civil aviation. In addition to Government sponsored projects, however, civil projects are also carried out. One of the most recent and interesting of these is the development, in co-operation with the North of Scotland Hydro-Electric Board, of a high-voltage overhead line fault detector.

The instrument and fire control laboratory is concerned with the design of complete fire control systems and high-precision gyroscopes and associated equipment for the guidance of ballistic missiles, guided weapons or aircraft. Probably, the most notable achievement of this laboratory is the development of AIRPASS (Airborne Interception Radar and Pilot's Attack Sight System) one of the most advanced and versatile airborne radar systems in the world which is used in the English Electric Lightning. A radar system has also been developed for the NA39 Blackburn Strike aircraft. In addition, this laboratory designs precision potentiometers, small motors and other electro-mechanical systems.

The vacuum physics laboratory specialises on research and development of special types of valves for both Government and civil projects. These include travelling wave tubes, noise tubes, magnetrons, broad band T.R. cells or transmit-receive switches, as used in radar. A wide range of microwave ferrite devices has also been developed. Production of valves and electricity meters is undertaken in the company's Dundee factory.

Machine tool control systems is another important activity of the Edinburgh factory and the Ferranti system of numerical control of machine tools has been described as one of the most successful so far developed in either Britain or the U.S.A. Recently, the company announced the introduction of two new economically-priced machine tool control systems acceptable to the small as well as the large engineering company. Both these systems, the transistor hydraulic continuous machine tool control equipment and numerical positional machine tool control equipment, represent a major technical breakthrough in this field.

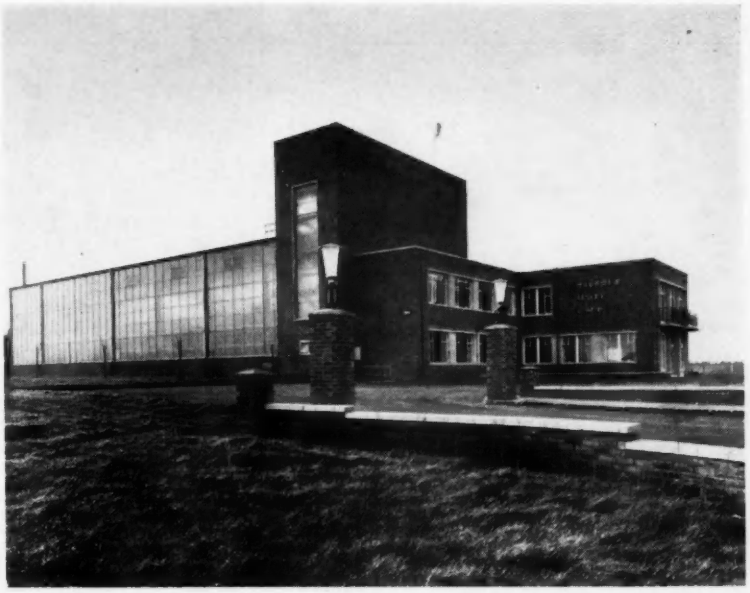
Like the unique co-ordinate inspection machine recently introduced by Ferranti Ltd., which provides a rapid means of inspection of machined workpieces to an accuracy of 0.001 in., the systems make use of diffraction grating measuring equipment. This measuring system has many other applications outside that of machine tool control.

Inertial navigation

One of the latest fields which the company has entered is that of inertial navigation. Last September a new £150,000 extension to the Crewe Toll factory—now used for the manufacture of inertial navigation instruments—was opened by the Minister of Supply. Entirely functional in appearance and providing an additional floor area of approximately 17,400 sq. ft. the new single-storey building is one of the most modern of its kind in the country.

It has been designed to meet the most exacting conditions called for in the development and manufacture of high-precision gyroscopes and accelerometers. Essentials are a dust-free atmosphere, rigid temperature control, controlled humidity and vibration-free testing facilities.

Today, Ferranti Ltd. employs approximately 2,800 in their Scottish group of factories and are the largest single employer in Edinburgh.



Exterior of the Balfour Group research and development centre opened on May 27 by the Secretary of State for Scotland.

The new Balfour research centre

ON May 27 Henry Balfour & Co. Ltd., opened their new research and development centre. The centre has a complete range of speciality process pilot plants for drying, evaporation, distillation, emulsifying size reduction etc., all designed for the progressive improvement of chemical process plants generally.

Processing systems

Here can be seen how processing systems can be analysed, tested and evaluated for clients' requirements before going into full-scale production. This centre is probably the most up to date of its kind in this country. It is full of interest on account of the numerous products involved, covering the chemical, gas, food, dairy, brewery, pharmaceutical industries etc.

Metallurgical testing and X-ray apparatus for foundry work and general fabrication to Lloyds Class One requirements can be seen in operation.

Metal fabricating shops

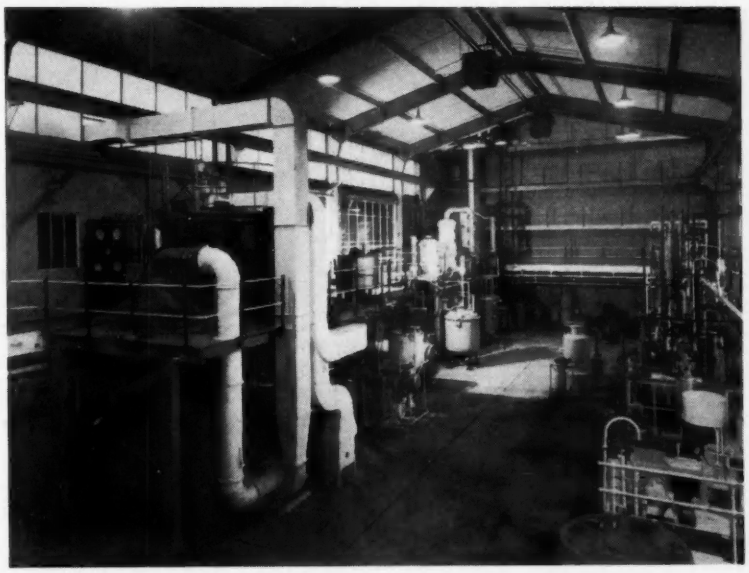
In the works, the mild steel, stainless steel, and alloy metal fabricating shops, are of interest, as well as the machine shop and pressing of dished ends. A most interesting process is the glass lining of vessels, which plays a vital part in all industries. The vessels are charged into continuously operated furnaces, where the glass is fused on to the metal at very high temperatures. Application of glass in its various processes prior to going into the furnace is also carried out here.

On the gasworks side are some mild steel trays for oxide for tower box purifiers, vessels for the new desulphuring plant of the Frodingham process, gas mains fabrication, small gasholders, and c.i. plates for various types of tanks.

Latest type of pump

Other plant will include the latest type of pump for dealing with sludge, slurries and semi-solids, also the new Wemco torque-flow pump for sewage and similar work, which is practically non-clogging. There will be prebreakers and disintegrators, which are used in many industries, and a new molecular still.

There are photographs on view of various plants already installed. These give the visitor a good indication of the sizeable contracts that can be undertaken by the company.



General view of the main pilot plant hall at the Balfour research centre.

A section of the welding shop, which has 18 spot-welding machines, in addition to some orthodox oxy-acetylene equipment. Argonarc apparatus has been installed to facilitate the welding of stainless steel.

Major changes carried out at Main's

MAJOR changes in factory layout carried out at the Gothic Works, Falkirk, of R. & A. Main Ltd., have now been completed. Within the G. & M. Group this factory is responsible for all fire production, part of the company's cooker production and the bulk of its catering equipment requirements.

Re-styling has achieved three objects; increased productive capacity, an orderly, easily-controlled flow of materials, and a cleaner, evenly-heated and more pleasant factory. The works is now divided into four workshop groups, the first of which is the cast iron group.

The foundry itself is worked as a floor foundry, with the moulding boxes being made up and rammed by hand. From the foundry, castings are taken to the adjoining dressing and fettling shop for cleaning, then on to the castings passing shop, where gas-carrying components are inspected and tested for soundness. From here the castings are passed to the machine shop.

The machine shop, which has only recently been revised in layout, carries out all machinery operations necessary on castings, the most commonly performed being the drilling of burner ports in hotplate, grill and oven burners. There are also heavier machines for the planing of castings, as for instance, the solid hotplates of catering appliances.

The pressed sheet iron group incorporates one of the largest and best equipped press shops in Scotland. Many components have to pass through six pressing operations before the final shape is attained. The welding together of components into sub-assemblies is carried out within the press shop.

The factory's finishing group comprises electroplating, painting and vitreous-enamelling shops.

Once fitting is completed each appliance is thoroughly tested before packaging. Co-ordinating all stages of manufacture and with the responsibility for the inspection and testing of all components and assemblies is the quality control department. In the background are the design and research departments which, in Falkirk, specialise in the development of catering appliances.

(A more detailed account of the works was published in our issue of May 4.)

Grangemouth

continued from p. 483

sulphur is despatched in lorries and rail tank wagons. Among its uses, the sulphur is manufactured into sulphuric acid and explosives.

Kerosine from the distillation units is treated with liquid sulphur dioxide to remove the aromatic compounds, which burn with a smoky flame. Two grades of kerosine are produced—ordinary burning oil, and a premium grade. The aromatic fraction is treated to produce a valuable blending stock for tractor vaporising oil.

Lighter products from the distillation unit have to be treated and blended to make them suitable for market requirements. One treatment is 'sweetening', which is carried out in copper chloride units. Another is the 'solutiser' treatment which improves the quality of motor spirit by extracting some of the sulphur compounds.

BP is one of the major producers of liquefied petroleum gas in the country and supplies butane and propane wholesale to marketing organisations who deliver in bottles to domestic and industrial consumers. Grangemouth Refinery produces 20,000 tons of L.P.G. a year. Its bottled gas filling plant has eight machines, capable of dealing with 2,800 bottles a day. Near the filling shed are four 25-ft. diameter Horton-spheres for storing butane gas, and nine propane storage tanks.

Distinctive features of Grangemouth Refinery are the two 200-ft high water cooling towers. Each cools 1,500,000 gallons of water an hour, equivalent to the water supply for a town of 900,000 inhabitants.

Burton's biscuits are baked by gas

THE Edinburgh factory of Burton's Gold Medal Biscuits Ltd., is the newest of its kind in Britain and is regarded as one of the most modern biscuit factories in this country. Burton's are part of Associated British Foods Ltd.

The ground site of the factory extends to over 12 acres and the main factory building occupies an area of about 150,000 sq.ft. Considerable thought has been given to the interior design and decoration, with emphasis on pleasant, hygienic working conditions.

All major raw materials are handled in bulk and distributed to weighers and mixers under electronic push-button control. The baking plant is gas-fuelled and consists of two T. & T. Vicars Thermojet ovens and one T. & T. Vicars Multiburner oven, each rated at 6,000 cu.ft. per hour. A 9-in. diameter gas service pipe and 35,000 cu.ft. per hour meter have been installed, together with internal installation pipes to supply the full potential demand, as it is planned to use gas for all baking.

Plans are now well-advanced for the installation of an additional oven. The canteen is a light and well-ventilated building, fitted with gas equipment manufactured by R. & A. Main Ltd.

Recognised as a model by health authorities, the factory is situated in Sighthill Industrial Estate, Edinburgh's first smokeless zone.

A general view of the Segas plant at the Isle of Grain.

Gasification at the Isle of Grain

By C. STOTT, M.C., M.Inst.Gas E., M.I.Chem., A.M.I.C.E., A.R.I.C.

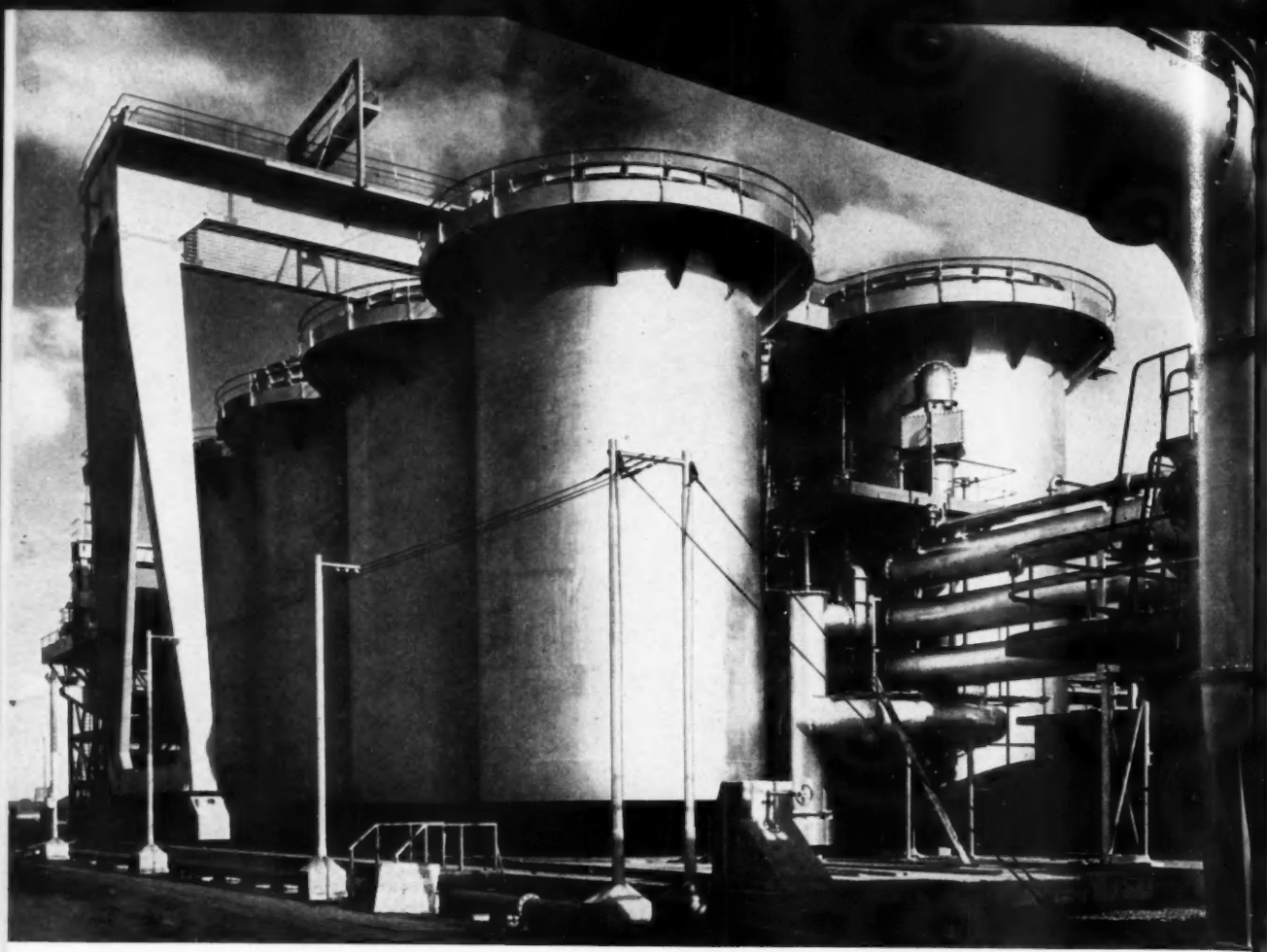
IN implementing the policy of integrating gas manufacture at major works advantageously sited, the South Eastern Gas Board sought a site for a works of some 72 mill. cu.ft. per day capacity on the Thames east of Gravesend.

At this time, the need for greater flexibility in the choice of manufacturing methods became urgent, and an agreement was made with the British Petroleum Co. Ltd., whereby the Board would establish a works adjacent to the company's Kent refinery and the British Petroleum Co. Ltd., would make available, over a satisfactory period of years, a range of feedstocks at its option.

The Board has accordingly established its Isle of Grain works. Stage I, based on the Segas process was commissioned in late October, 1958. Stage II, based on the Shell process of gasification at elevated pressures, is in course of construction and will be commissioned late in 1960. A further stage of development is planned, Stage III, consisting of a duplication of the additional gasification and gas treatment plant installed at Stage II.

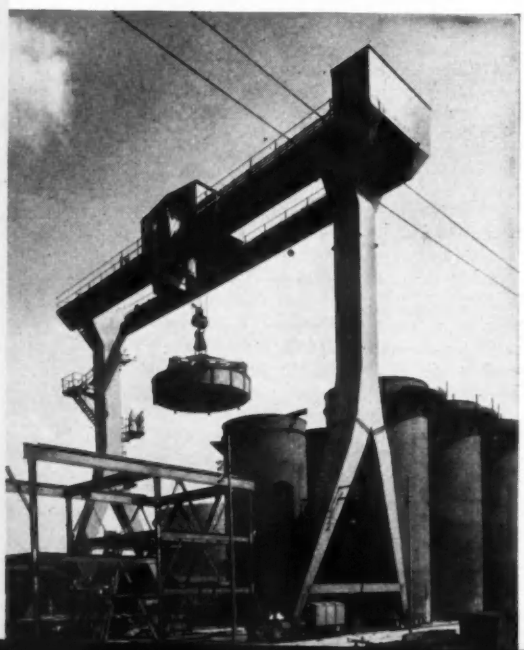
Changes in the fuel position in the Board's area during the past four years have shown that parity in gas production by carbonisation and gasification plant can no

Mr. Stott is Chief Engineer of the South Eastern Gas Board.



Tower Purifiers with Mechanical Oxide Discharger recently completed at the Isle of Grain Works of the South Eastern Gas Board, capacity 16/20 million cubic feet per day.

NEWTON CHAMBERS



Progress in Gas Purificatio

Recent contracts include :-

***MECHANICAL OXIDE DISCHARGER**—Six units in operation, or in course of construction.

***AUTOMATIC VALVE OPERATION FOR SEQUENCE ROTATION**—First operator on order for the East Midlands Gas Board, Scunthorpe.

***HIGH PRESSURE PURIFIERS**—First British installation of High Pressure Purification Plant (Bischoff) received from Humphreys & Glasgow Ltd. for the Scottish Gas Board's Westfield project.

***PLATED GOLIATH CRANES**—For ease of maintenance.

Tower Purifiers with Mechanical Oxide Discharger, capacity 18 million cubic feet per day, under erection at the Coatbridge Works of the Scottish Gas Board.

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longer be held because the production of coke exceeds the demand and the balance of plant will become, at the end of the year, coal gas 42%, water gas 40.5%, oil gas 17.5%.

Stage I of the developments employs the Segas process which normally uses, as feedstock, light oil distillates or heavy fuel oil, although, with special plant modifications, refinery gas can also be successfully employed. The process is based on the cracking of the feedstock when passed with steam through a catalyst maintained at a suitable temperature. The reactions are strongly endothermic necessitating cyclic operation similar to water gas production. The loss of heat from the catalyst during the gas-making period (the run) is restored in the heating period (the blow), safety purges being interposed between these periods. The thermal efficiency of the process is reasonably high due to the incorporation of regenerators, steam superheater and air preheater, which return to the catalyst in the reactor the excess heat carried from it by the 'blow' and 'run' gases.

The make gas is, therefore, a blend of a true oil gas and water gas together with a minor element of waste gas. Process conditions are controlled to give the blend the standard calorific value of 500 B.t.u. per cu.ft.

Characteristics of the gas produced are given in Table I.

TABLE I.

	Using light distillate	Using heavy fuel oil
Per cent CO_2	3·1	11·4
O_2	1·0	0·5
CnHm ..	5·5	6·8
CO	14·4	14·7
H_2	53·1	47·3
C_2H_6 ..	0·3	0·6
CH_4	16·0	13·8
N_2	6·6	4·9
Total	100·0	100·0
Calorific value	500 B.t.u. per cu. ft	500 B.t.u. per cu. ft
Specific gravity ..	0·45	0·58
Wobbe Index	740	645

In the Segas process, which involves gas flow through vertically placed cylindrical vessels, the relative sizes and internal contours of the different components are important factors in securing uniform and optimum conditions of gas flow The four Stage I plant units, each with a capacity of 4 mill. cu.ft. per day, were therefore designed as modified versions of the 1 mill. cu.ft. per day pilot plant at Sydenham. The modifications are indicated as black section 1 to 6 in the accompanying diagram.

In the Sydenham plant, a 6 ft. bed of catalyst was used in a vessel of 6-ft internal diameter, while in each of the Grain vessels, a 6-ft. bed of catalyst was carried in a vessel 11 ft. 9 in. in diameter.

The modifications include:

(1) Throat at top of reactor.
(2) Throat at bottom of reactor.
(3) Baffle in bottom cross-over to reactor.
(4) Restriction at base of air-preheater
(5) Restriction at bass of steam preheater.
(6) Special perforated dome at base of reactor.

The decision not to extend the Segas plant beyond Stage I, but to continue with Stage II, based on the Shell process at high pressures, was made with the following considerations in mind: Although cyclic cracking processes can be operated successfully to produce gas at a controlled calorific value, and are flexible in output, they are not, however, basically satisfactory in that they demand the simultaneous production of oil gas and water gas in the same vessel in such proportions as to give a predetermined calorific value. The inherent difficulty is that the requirements of the two main reactions are divergent. Cracking should be conducted at a minimum temperature to avoid degradation and excessive carbon production, while the water gas reaction is favoured by high temperatures. Chemical processes are operated to the best advantage when dealing with a single reaction in one stage. Under these conditions, design can be directed to a specific objective, and closely defined process conditions can be applied with certainty.

The Shell gasification process is primarily a continuous process for the production of water gas in a high pressure generator, by the non-catalytic partial oxidation of petroleum hydrocarbons when fed with oxygen and steam

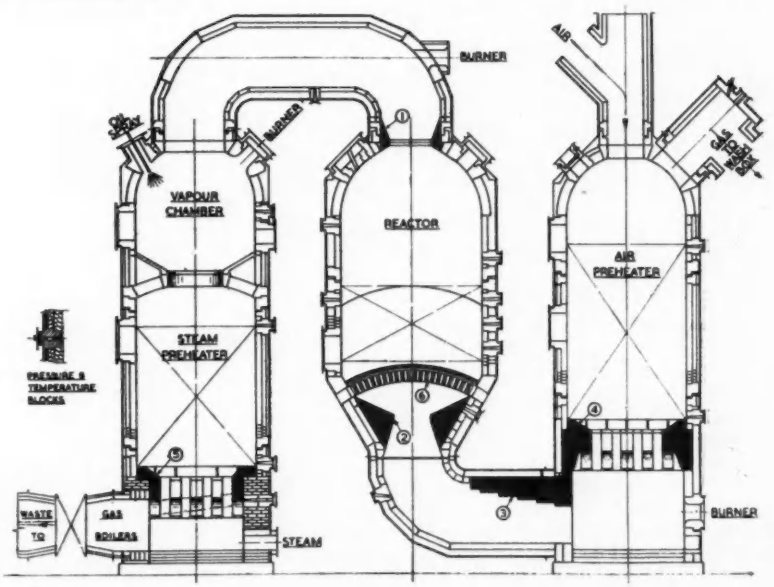

Diagram of modified Segas plant at the Isle of Grain works

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to a combustor where they are intimately mixed before entering the reaction zone.

In order to reduce oxygen consumption, the oxygen and feedstock are preheated in separate heaters before being fed with superheated steam to the reactor. The feedstock can range from methane to heavy fuel oil of 3,000 sec. viscosity.

The decision to employ the Shell process was reinforced by the recommendation that all new manufacturing plant should be capable of producing gas containing less than 5% of carbon monoxide and less than 5 grains per 100 cu.ft. of organic sulphur.

The further treatment of Shell gas for the removal of sulphur, conversion of carbon monoxide, secondary sulphur removal and removal of carbon dioxide can be used to produce a gas of approximately 300 B.t.u. per cu.ft. which can then be enriched with high B.t.u. gas and ballasted with nitrogen obtained as a by-product of oxygen manufacture, to provide a mixed gas having the required characteristics.

The Shell gas after final treatment consists of 90 to 92% hydrogen and has a specific gravity of 0.19. The components of the final gas mixture at Stage II of the development of gas production under conditions of maximum output will be as shown in Table II.

TABLE II.

Components of Final Gas Mixture.

Component	Volume (mill. cu. ft. per day	Calorific value (B.t.u. per cu.ft.)	Specific gravity (Air=1)
1	2	3	4
(*a*) Segas	16·0	445	0·52
Refinery gas	0·65	1,850	1·10
Mixed	16·65	500	0·543
(*b*) Hydrogen	18·0	305	0·19
Refinery gas	2·6	1,850	1·10
Mixed	20·6	500	0·305
(*a*) + (*b*)	37·25	500	0·41
(*c*) Nitrogen	5·42	—	0·97
Refinery gas	2·02	1,850	1·10
Mixed	7·44	500	1·006
Total (*a*)+(*b*)+(*c*)	44·69	500	0·51

Plant and processes for treatment of the water gas produced in the Shell gasification units are described. The Alkazid process is used for the removal of hydrogen sulphide in an absorber through which glycine lye passes.

The hydrogen sulphide and approximately an equal volume of carbon dioxide removed in regenerating the wash liquor are passed into the Segas gas stream or into the refinery gas stream and absorbed in the existing low-pressure system of tower purifiers.

For the conversion of carbon monoxide, the gas from the Alkazid plant enters a water saturator. High pressure steam is then added, and the gas passes to a catalytic converter where the carbon monoxide and water vapour interact to form CO_2 and hydrogen.

The gas from the conversion plant passes to a set of high-pressure tower purifiers containing iron oxide for removal of hydrogen sulphide, after which it passes up an absorption tower where the CO_2 is removed under pressure by downward-flowing lye of potassium carbonate at about 80°C. The saturated lye is then expanded through a special turbine and delivered to the top of a pre-de-gasser where part of the CO_2 is driven off. The remainder of the CO_2 is then removed in a ring-filled degasifier by means of a current of air and steam.

DISCUSSION

Mr. R. H. Sandford Smith (Deputy Chairman S.E.G.B.): A new major works was needed and the decision about that proceeded on two lines. First of all, where could we find a site, which is not easy in London, and secondly, what plant should be installed? In looking for a site, we began with the approach which is traditional to London. You go to the eastern side of it and start from there and go on until you find some marshland that is unoccupied by anyone else. That is how Mr. Stott, with a great deal of research eventually discovered the site at Gravesend.

Since we were thinking of oil products, we made an approach to the Kent oil refinery and they showed immediate interest in our proposals. It appeared that they would value a customer for a substantial quantity of oil products which they would be free to vary at reasonable notice, and so enable them, to the extent of this contract, to vary their production according to the changing market requirements. From the Board's side, this advantage could be reflected in a favourable price for oil feedstocks. On the basis of this arrangement, they agreed to lease us a site immediately alongside the refinery. Since the beginning of this arrangement, our relationship with the Kent oil refinery has been very close and much more than that of merely supplier and customer. The refinery has, for example, been able to supply us with a maintenance service, canteen facilities and so on, which we should otherwise have had to construct for ourselves. In this respect, we have got a very happy partnership between private enterprise and a nationalised industry.

An essential feature of the arrangement was that we should be able to vary the type of feedstock which we should receive. The first installation of Segas plant has been able to deal with all the products which were made available to us within the fairly wide specification we agreed at first. It has dealt with products from refinery gas to 950-second oil, but changing the feedstock has had its temporary difficulties. Later in our association, the refinery were able to make greater quantities of refinery gas available. At the present time, the Segas plant is working very satisfactorily with two plants on heavy oil and two plants on refinery gas. This experience of dealing with different types of feedstock and the advantages Mr. Stott mentioned of changing from cyclic plant to continuous plant, called attention to the need for a plant which was as tolerant as possible of feedstocks. That is the best of using high pressure gasification plant.

There is one important advantage of an oil refinery, which applies also to the Board's gasification plant. All the raw materials reach the plant by pipeline, and there is practically no handling of solid material in or out. It makes a striking comparison with ordinary gasworks of the same capacity, with all its plant for handling coal, coke and other materials, to look down at the open trench beside the entrance to the Isle of Grain works and see four or five pipes which are bringing in all the raw materials required for the works and, at the present time, some of the services drawn from the refinery, such as steam and water. This ability to handle all the raw material and intermediate products by pipeline results in a great economy of capital and labour by comparison with a conventional gasworks.

Mr. Stott has given detailed figures showing the present and future capital costs per therm of output. On the labour side, the total complement required of staff and manual labour at the present stage of 20 mill. cu.ft. per

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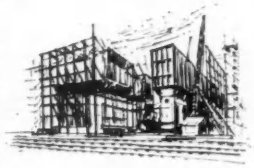

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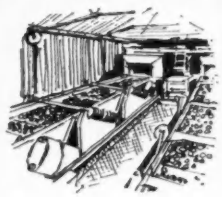

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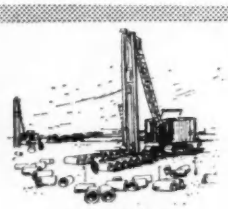

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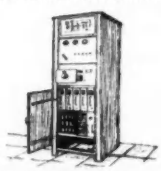

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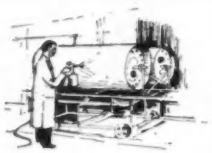

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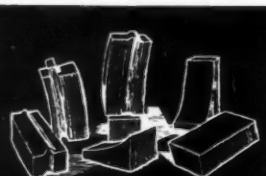

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day output is little more than 100, which would be perhaps only one-third of the number required at a conventional works making the same amount of gas.

I found it very interesting yesterday to hear the account given by Mr. Ricketts of the high pressure gasification plant which is being constructed at Westfield. There is one major difference between the two schemes in that coal is the raw material at Westfield and oil at the Isle of Grain. There are, however, at least three important features that the schemes have in common: Although the distances involved and conditions of supply in Scotland differ so much from the South of England, it is interesting that it has been found possible in both cases to obtain the great advantage of placing the gasworks immediately alongside the source of raw materials. Secondly, both the Westfield plant, and the Isle of Grain plant in its second stage, will be operating at high pressures and with the use of oxygen to produce gas of much greater purity, free of sulphur and low in carbon monoxide. Thirdly, because of the nature of such plant, each stage of construction has to be of substantial size; the first stage of the Westfield plant is 15 mill. cu.ft. per day and the first stage at the Isle of Grain was 20 mill. cu.ft. per day, to be followed by further stages of roughly equal capacity.

In view of what Dr. Burns said yesterday, perhaps those stages are even on the small side, but we shall no doubt consider that in future.

Pattern for the future

It seems to me that, in these three respects, siting alongside raw materials, gasification at high pressure, and scale of production, these two plants will be the pattern to which we may expect future installations of gas manufacturing plant to conform.

For that reason, it would be most interesting to visit the Westfield plant, and I hope your members will have the opportunity of visiting the Isle of Grain at their meeting in London.

The plant which is being installed for the second stage of the Isle of Grain, for high pressure gasification of oil, high pressure purification, and the production of gaseous and liquid oxygen, is new to the gas industry in this country. I found the paper presented by Mr. Stott of the greatest interest, because he sets out so clearly the requirements of the different processes and how these have been met in the design of the plant. With this evidence that the operating conditions are fully understood and provided for, I am confident that the new plant will provide a high standard of performance, both in cost and gas quality.

Mr. T. C. Finlayson (Woodall-Duckham Construction Co. Ltd.): Reference is made in the paper to the fact that this scheme owes a great deal to the leadership of Mr. W. K. Hutchison, at that time Chairman of the South Eastern Gas Board. It is, of course, no coincidence that the inspirer of that scheme is now President of the Institution of Chemical Engineers, because the whole plant is, in fact, a complex chemical engineering plant. I think it is worth recording, as anybody who sees this plant in due course and the plant this afternoon must realise, that the modern gas engineer, to meet the challenge of the future, must also be a chemical engineer, and we have to see to it that, within the industry, we can produce and train people who can operate such different types of plant, and also maintain them.

The second general observation I would like to make, which I find most fascinating, is the reference [on p. 9 and 10] to the underlying reasons for choosing the Shell-gasification process for Stage II, and the change in supply of refinery gas even while Stage II was under construction. I think it may be worth reminding ourselves that those who have been working in this industry for some time, worked for the first 25 years on trying to find cheap enrichers to add to cheap lean gas. In other words, to find the cheapest way of making an enricher to add to the cheap lean gas. Now we are concentrating on finding the cheapest way of making a lean gas to add to cheap enrichers.

I think it is worth recording a sort of axiom or text which we might put on our research and development programmes at least to do with fuel, and that is that, whereas technical development has a definite time progress scale, the political considerations and the commercial considerations affecting supply and demand can and do change overnight. The moral, of course, is to have—and one must have—a variety of gas-making plants and not put all one's eggs in one basket.

The final point I would like to make, which I think is relevant to the present time, and I regard it as possibly the most fascinating point of the next few years, is that of finding out how these most fascinating and interesting and highly efficient processes, which we are discussing today, and discussed yesterday, are going to stand up to the test of reliability, using oil or coal under conditions, of course, where continuity of supply to meet statutory obligations are quite bracing. Quite a number of those processes have come from the chemical industry which has not had quite that same problem.

I think it shows once more the importance of the policy which is now well established of the linkage of mains so that a variety of plants can be interlinked.

Mr. D. P. Haines (Power-Gas Corporation Ltd.): Mr. Stott's paper is a comprehensive account of the planning and construction of the first phase of the building of a new works and of the design study of the second phase of construction. Both phases at the Isle of Grain give a practical form to the Gas Council's plans for the future development of the industry. Stage I has a particular significance for the South Eastern Gas Board. The decision in 1956 to install a group of Segas units as base load plant, followed development work which had been carried out at Old Kent Road and on the pilot plant at Sydenham, work with which my company are happy to be associated. When the decision was taken, the entire gas-making capacity for an eventual production of 80 mill. cu.ft. per day was intended to be produced from Segas plant. Subsequent studies by the South Eastern Gas Board, which confirmed earlier studies carried out by my own company for the Wales Gas Board, showed that for plant capacities greater than 20 mill. cu.ft. per day, considerable advantages could be achieved from high-pressure oxygen gasification, and thus the possibility of further units of Segas plant at this works has now receded. Nevertheless, the four units now in operation have been acting as base load plant for the past 18 months and have gasified considerable quantities of a wide variety of feedstocks.

Tendency towards optimism

The selection of the feedstock to be gasified has acquired, over the past five years, rather more significance than was given to it in earlier work on catalytic gasification reported to the Institution. Earlier results from the pilot plants at Sydenham and York had not disclosed the effects of the constituents of the feedstock, especially those of heavy oil, and there was a tendency to be optimistic as to the results achievable from heavy oils taken at random, without care being given to the selection.

Subsequent experience in many full scale oil gasification plants over the past six years has shown that, although a wide range of feedstocks can be gasified, problems arise with the handling and disposal of the by-products of certain

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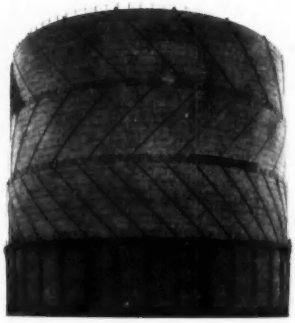

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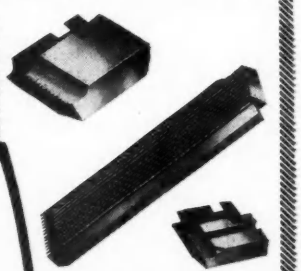

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of the feedstocks. The requirement of town gas production plant, as with any other process, is that its by-products, if they are to be tolerated, should either be profitable to sell or easy to dispose of as waste. With certain processes, for example the Jones process, the financial recovery from the by-products may be the difference between economic success or failure.

Experience has shown that oils can be selected which have acceptable characteristics in respect of the by-products produced, and some general rules can be formulated which will assist in the consideration of the suitability of an oil for gas making. Special economic factors, related perhaps to the location of a plant or special price arrangements can, of course, have strong influence on such considerations.

Generally, straight run residues or blends of these are preferred. They should be substantially free from fractions which are already cracked. Oils containing much recycle oil from catalytic crackers (added to reduce viscosity) tend to have high carbon : hydrogen ratios. Mr. Stott has drawn attention to the difficulties encountered when using a heavy residue 'cut-back' with a light fraction. In considering the origin of the oil, those from Venezuela and Kuwait are less desirable, the first because of the high vanadium content and the second because of high carbon : hydrogen ratios arising from the presence of large amounts of asphaltic material.

The sulphur content of the gas made, both as hydrogen sulphide and organic sulphur, is broadly proportional to the sulphur content of the oil. A maximum limit of 3.5% sulphur is desirable, with 2.5% being preferred. Evidence is still rather confusing regarding the concentration of sulphur compounds which actually occur in the gas, and it is not yet possible to predict with accuracy the exact amounts to be expected from a particular oil.

The ash content and the vanadium content should be as low as practicable. Excessive quantities of these constituents may lead to great frequency of repacking of the catalyst. It is, of course, technically desirable to employ an oil with as low a carbon : hydrogen ratio as possible in order to reduce the amount of carbonaceous by-products. In general, the type of oil given in [Table 3b] represents a fuel oil of fairly desirable properties. Comparison of the results given by Mr. Stott with those given in Mr. Ward's paper two years ago will show the improvement obtained in results, both with heavy oil and light feedstocks when an oil of better characteristics is used.

A question of convenience

In making these remarks on the suitability of an oil for gasification, I would like to emphasise that oils with poorer characteristics can still be gasified but with greater inconvenience. For example, tests have been made with topped crudes which were difficult to pump. The fairly thick tar which was produced in the washbox could have been handled with special arrangements. If the price were right for such a feedstock, a case might be made for its use.

I would like to conclude with a comment on a feature of design not given special attention by Mr. Stott. The hydraulic control system provided for the Isle of Grain plant is of an identical type to that provided as standard equipment on my company's c.w.g. and Segas plants. This design was, by a happy coincidence, first installed on the c.w.g. plant at Sydenham, now a South Eastern Gas Board station. The installation at Grain is unique in respect of its extent and size. The controllers for all plant are located in the central control room, the pipelines being led back along a pipe bridge which also carries several other units' services. The extended layout of the plant meant that impulse lines over 400 ft. long were required for the farthest units and therefore, to reduce pressure losses, the pipe sizes along the bridge were doubled in area from the largest previously in use. The purging of air from such a long and extended piping system proved to be an awkward task but suitable techniques were established, and the system was brought to function just as well as the standard and more compact units. Furthermore, the basic design demonstrated its inherent flexibility, when to meet various process design changes, three additional control valve systems and four new interlocks were added later.

Dr. D. K. Holliday (Woodall-Duckham Construction Co. Ltd.): As one of those who have been engaged in the design and construction of the Stage II development at Isle of Grain, I would like to congratulate Mr. Stott on his factual and informative paper. The amount of technical data and costs given in the paper must be welcomed by all interested engineers. It should, perhaps, be pointed out that the utility quantities presented in this paper are design figures. The subsequent papers which I am sure will be devoted to Isle of Grain will no doubt provide actual operating data to show how the design expectations have been met.

Compactness of plant design

In the paper, Mr. Stott has mentioned the compact nature of the design of the Shell and ancillary plants. In fact, the design adopted at Isle of Grain is probably the most compact and space saving ever achieved for an oil gasification plant. The Shell gasifiers, Alkazid plant, CO conversion and CO_2 removal plants for the production of 36 mill. cu.ft. per day of hydrogen gas will all be accommodated in an area 260 ft. long by 210 ft. wide.

In discussing the Shell gasification process, the important rôle played by instrumentation should be stressed. In operation, the plant will be controlled entirely from the central control room and is automatic except for one human link in the chain. This ensures that the oxygen supply is adjusted to give the correct methane content in the gas produced. This control could also have been made automatic, but it has been found by experience that the interpolation of a human link into an otherwise automatic circuit is often desirable.

The Alkazid plant will be the first application in this country of this particular method of removing hydrogen sulphide from town gas. In regard to corrosion, it can be stated that the lye is entirely passive at the temperature of gas scrubbing, but becomes corrosive at the temperatures used for stripping hydrogen sulphide from the lye. This corrosive tendency at higher temperatures has been taken fully into account in the design of the plant.

Mr. Stott cites the heat exchange equipment of the carbon monoxide conversion plant as a first rate example of the application of chemical engineering practice to process control. It may be of interest to note that the steam consumption of this plant would be two to three times higher without heat recuperation.

With the exception of certain special pumps and compressors, all the equipment for the plant has been manufactured in this country, and in general, the mechanical design of the Continental plants to the standards of the United Kingdom gas industry has given little trouble.

In translating these plants developed on the Continent to British conditions, it has been throughout my company's ambition to provide processes tailored to the needs of the modern gas industry.

We feel that the experience gained during the design and the operation of these new processes will be of value to the whole industry in connection with other major schemes now under consideration.

Mr. K. W. Francombe (Whessoe Ltd.): In the few moments that are left, I would like to spare a thought for

the operators of the plants which we have heard discussed this morning: The W-D/Shell gasification plant and the H. and G. Lurgi Westfield gasification plant. I feel that, as both these plants will, we are told, be started in the autumn of this year, and as they are of a very complex nature, we should wish the operating teams of both of the plants the very best of luck because, as an operator many years ago, of orthodox plants, I do realise that the teams that will be engaged on this work are going to have a lot of headaches, and some very sleepless nights. I think the station engineers, the contractors' operating teams and the project design teams, who will no doubt be getting together on these plants, do deserve our very best wishes for a great success.

Mr. Stott, in reply: There were a few points which could be picked out. There was one on the effect of scale and I do not think that really needs emphasising. To have a works of which the output is finally going to be less than 80 mill cu.ft. per day is not economic. We have enough experience now on capital outlay to know that it is only the really big units that you can afford.

On the training of personnel mentioned by Mr. Finlayson, that is a thing that is very much in mind and is a very great problem to the industry. We have adopted a principle of having special process engineers in charge of each section of the plant and they are directly responsible for it; and in advertising and interviewing for these posts, you do get some idea of the gaps which we have to fill in the way of training and experience.

I am glad the point was emphasised of the tremendous change there was in the respective importance of the prices of lean gas and rich gas because that is one of the basic thoughts now behind the industry's thinking.

I was glad Mr. Haines spoke, because he was in charge of all the site operations and while on the job, I know we gave him a tremendous number of headaches.

There was the question of instrumentation on which, if you will look at the capital costs, you will find that we spent a quarter of a million pounds. We make 20 mill. cu.ft. per day with 90 men in all. These include everybody from the station engineers and any form of maintenance, and the number of men on the plant which instrumentation replaces was between 800 and 900, so that we have not regretted the expenditure, but it did mean that from the control room we were faced with getting out 400 different types of service. That was all in the quarter of a mill. pounds and it means the whole of the operations can be controlled from the control room, all adjustments made to flow rate, and every indication of temperature and pressure given on the board in front of the operator.

Dr. Holliday referred to the compact layout of the plant, and there is a point I have always been uneasy about, because when we did stage I, we left a space defined by the roads as a duplication of the Segas plant. That was the mirror of another 20 mill. cu.ft. per day. We have not done it and it so happens that we have 36 mill. cu.ft. of hydrogen on the same site. It is not often anything in actual practice happens like that. It looks quite compact, but when you get on the site, you find there is adequate room.

Mr. Francome's good luck wishes to the operators almost sounded to me like an operation in the first world war—going over the top! But I think there has been enough foresight there to make the operators, when they go in, have a square deal to start with.

PERSONAL NOTES

MR. S. A. STEWART, C.B.E., has been appointed Director, British Road Tar Association. Educated at Winchester and Royal Military Academy, Woolwich, he was commissioned into the Royal Engineers in 1924, from which he retired with the rank of Brigadier. Throughout his service he specialised in engineering. He spent two years on loan to the staff of Sir Alexander Gibb & Partners at the building of the Kincardine-on-Forth bridge. For five years he was superintendent of the Experimental Bridging Establishment (now MEXE) at Christchurch. Later he was deputy director of fortifications and works in the War Office. His last appointment before retiring at the end of 1959 was Director of R.E. equipment, Ministry of Supply, in which he was responsible for the design and production of all bridging, plant, roadmaking equipment, etc., used by the Royal Engineers.

MR. D. W. BAKER has been appointed Exeter District Manager of the South Western Gas Board in succession to the late Mr. C. H. Gilbert. Mr. Baker was for a period assistant to the divisional engineer and manager, Plymouth and Cornwall Division, after which he was appointed work study engineer at the Board's area headquarters at Bath. He then took up the post of commercial assistant, Bristol, before becoming deputy district manager, Exeter.

BIRTHDAY HONOURS

The Queen's Birthday Honours list includes the following:—

C.B.—MR. OWEN FRANCIS, Under-Secretary, Ministry of Power.

O.B.E.—MR. E. H. HARMAN, Deputy-Chairman, East Midlands Gas Board.

MR. F. B. THOLE, formerly principal scientific officer, Ministry of Power.

M.B.E.—MRS. M. F. LAYNE, formerly private secretary to the Chairman of the Gas Council.

B.E.M.—MR. J. AUSTIN, Distribution Foreman, Hither Green Depôt, South Eastern Gas Board.

MR. P. J. SMITH, District Fittings Foreman, Harlow, Eastern Gas Board.

COMING EVENTS

June 20-21.—I.G.E. EASTERN SECTION: Clacton. Annual General Meeting. Chairman's Address and paper on 'Operation: Selling.' by A. R. Turner.

June 22.—I.G.E. SOUTH WESTERN SECTION: Bath. Summer Meeting and Ladies Day.

MR. ALAN HOLT, deputy engineer and manager of Brighouse District of the North Eastern Gas Board, has been appointed District Manager of the Spenborough District.

OBITUARY

MR. W. E. CONE, O.B.E., formerly technical adviser of the British Road Tar Association, has died, at the age of 73. Mr. Cone was appointed technical adviser in 1925 to the Joint Road Tar Committee, representing the gas, coke oven and tar distilling interests, which was the forerunner of the British Road Tar Association. He was appointed technical adviser of the B.R.T.A. on its formation and held this office until his retirement in 1958. Before the Road Research Laboratory was formed, Mr. Cone organised practical road trials with the co-operation of the Ministry of Transport, and throughout his long years of service with the Association he was the spearhead of its technical activities. He played a prominent part in the formation of the International Road Tar Conference in 1931 and was its first secretary. He was esteemed by engineers and contractors, both at home and abroad, because of his profound knowledge and practical understanding of the use of road tar for road construction and maintenance. His charm and graciousness, combined with a true dignity, earned him the affection and respect of a very wide circle of friends.